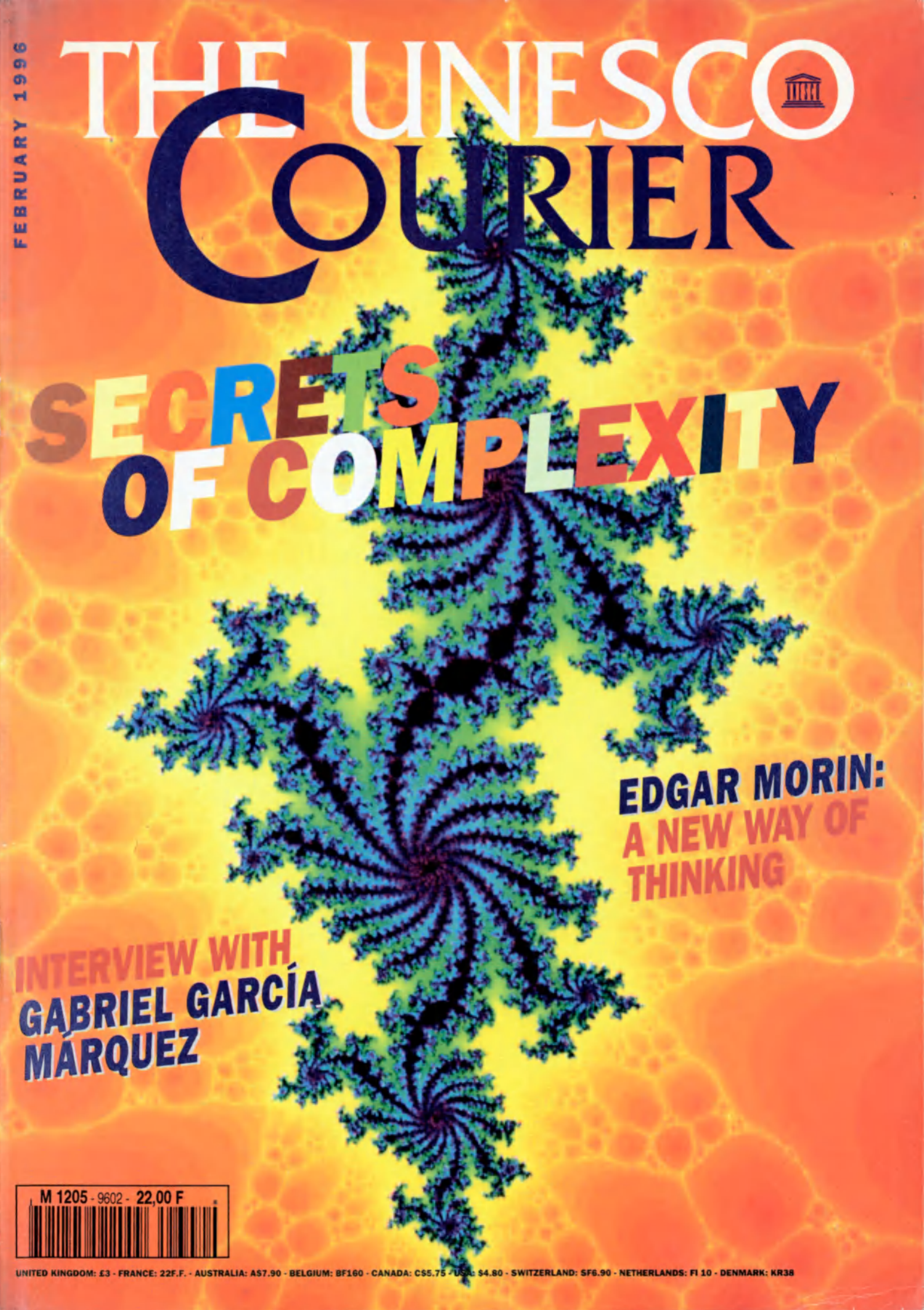
FEBRUARY 1996

THE UNESCO COURIER



SECRETS OF COMPLEXITY

EDGAR MORIN: A NEW WAY OF THINKING

INTERVIEW WITH GABRIEL GARCÍA MÁRQUEZ

M 1205 - 9602 - 22,00 F

UNITED KINGDOM: £3 - FRANCE: 22F.F. - AUSTRALIA: A$7.90 - BELGIUM: BF160 - CANADA: C$5.75 - USA: $4.80 - SWITZERLAND: SF6.90 - NETHERLANDS: FI 10 - DENMARK: KR38

ENCOUNTERS

We invite readers to send us photographs to be considered for publication in this feature. Your photo should show a painting, a sculpture, piece of architecture or any other subject which seems to be an example of cross-fertilization between cultures. Alternatively, you could send us pictures of two works from different cultural backgrounds in which you see some striking connection or resemblance. Please add a short caption to all photographs.

The dance of life
1993, paper cutout by Lesya Bespalova

The art of making paper cutouts, practised in both East and West, is particularly popular among the Slav peoples. Artist Lesya Bespalova was born in Ukraine, where paper cutouts are known as *vitinanka*. In this sample of her work fantastic dancing creatures evoke the joys and mysteries of life.

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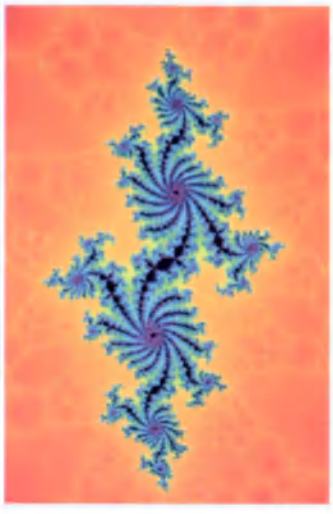

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A computer-generated image based on a fractal geometry formula.
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Consultant: *Edgar Morin*

THE UNESCO COURIER
49th year
Published monthly in 30 languages and in Braille

"The Governments of the States parties to this Constitution on behalf of their peoples declare,
"that since wars begin in the minds of men, it is in the minds of men that the defences of peace must be constructed . . .
"that a peace based exclusively upon the political and economic arrangements of governments would not be a peace which could secure the unanimous, lasting and sincere support of the peoples of the world, and that the peace must therefore be founded, if it is not to fail, upon the intellectual and moral solidarity of mankind.
"For these reasons, the States parties . . . are agreed and determined to develop and to increase the means of communication between their peoples and to employ these means for the purposes of mutual understanding and a truer and more perfect knowledge of each other's lives. . . ."
EXTRACT FROM THE PREAMBLE TO THE CONSTITUTION OF UNESCO, LONDON, 16 NOVEMBER 1945

Gabriel García Márquez

The writer's craft

■ Is it possible to protect culture?

Gabriel García Márquez: The major question that governments and people interested in culture should ask is what kind of protection the state can offer to culture without interfering in it and manipulating it or, most important of all, without making it subservient to the government's political philosophy. The trouble with culture ministries in Latin America is their subordination to the vicissitudes of national politics. A cabinet crisis has repercussions on cultural activity. Power struggles within the government result in the appointment of a culture minister who has no interest in culture or is opposed to the previous minister's policies. Consequently culture depends on a series of comings and goings that have nothing to do with culture but everything to do with politics, and worst of all, with partisan politics.

Culture should be helped by establishing the conditions in which it can develop freely. But in practice this creates big problems. It's impossible to predict the workings of creativity or to plan anything creative. What's more, how can you do anything about culture without defining what you mean by culture?

According to UNESCO, culture is what people add to nature, everything that is produced specifically by human beings. I believe that culture is the social use of human intelligence. Deep down we all know what the term "culture" means, but we have a hard time summing it up in a few words. Culture may be—I think it was France's former Minister of Culture, Jack Lang, who said this—all kinds of things—cooking, a way of being, of making love, of living, and mixed up in all this, the arts. Every act has cultural overtones. The danger is that the wider the concept of culture, the harder it is to know how to protect it.

■ Can culture be taught?

G. G. M.: At the moment I'm wondering how the arts, literature, journalism (which, to my mind, is a form of literature) and the cinema (which is most certainly an art) should be taught. Education of this kind must be a one-off, it must be informal.

At the cinema school in San Antonio de Los Baños in Cuba I have a workshop called "How to tell a story", where I sit a maximum of about a dozen young men with scenario experience round a table. We try to see if it is possible to create stories collectively, to see if the miracle of creation is possible round a table. Sometimes we've brought it off. I start off by asking one of them about the most recent film he's seen. "Tell me what it's about," I say. Some of them know how to tell a story, others don't. One might answer, "It's the story of a country girl faced with the contradictions of modern city life." Then his neighbour will say, "A country girl is bored with her family, so one day she hops onto the first bus that goes by. She runs off with the driver and meets. . . ." And he starts to tell the girl's story episode by episode.

The first young man is gifted, but he'll never know how to tell a story. He hasn't been born with the gift of storytelling. The other fellow, who knows how to tell a story, still has a long way to go before becoming a writer; he's got to acquire the technique and—something that's extremely important—basic culture. I cannot imagine how anyone could even think of writing a novel without having at least a vague idea of the ten thousand years of literature that have gone before, if only to know his or her own standpoint. And then the writer must settle down to a daily routine of work because inspiration doesn't fall from the sky. You have to work at every word, every day of the week.

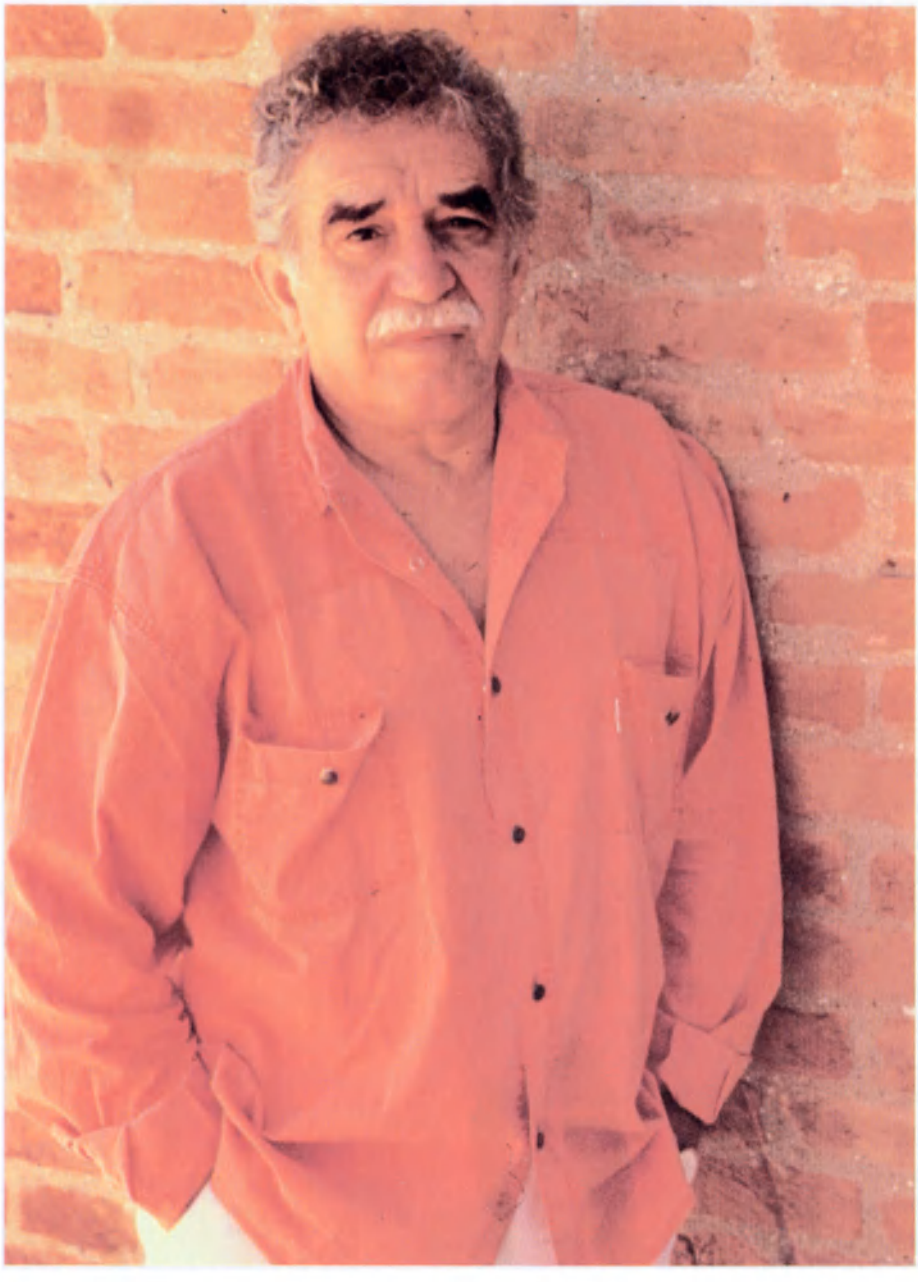
Writing is a craft, a difficult craft that requires a lot of concentration and discipline, as do painting and composing. By working at it, someone who knows how to tell a story will become a writer; someone else, however hard he or she works, will never make it. It's the same with music. If you teach your children a melody, some will be able to repeat it exactly; others will never learn.

■ Do you regard yourself as an intellectual?

G. G. M.: Not entirely. An intellectual, it seems to me, is someone with more or less preconceived ideas that he or she is constantly trying to compare with

'It's impossible to predict the workings of creativity or to plan anything creative'

A master of modern letters, winner of the 1982 Nobel Prize for Literature, the noted Colombian writer talks to Bahgat Elnadi, Adel Rifaat and Miguel Labarca about creativity and his conception of the writer's craft.



Roberto Graziol Grazia Neri © Sygma, Paris

reality. In fact the intellectual tries to interpret reality through his or her preconceived ideas. I live off anecdotes, off the happenings of everyday life. I try to interpret the world and create art through experience of everyday life and the knowledge of the world that I gradually acquire, without preconceived ideas of any kind. That's why interviews, where the questions oblige me to give abstract answers, are very hard for me. My starting point has to be a real fact. That's how I function as a writer. I think I could prove that every line in my books has been inspired by a real fact, something that I was either told, or that I experienced or knew about.

■ **In your world, knowledge encompasses many things. . . .**

G. G. M.: That's true. People have said that my novel *One Hundred Years of Solitude* contains incredible things that could never have happened. But for me these things correspond to real-life experiences. Some of my reading has marked me for life, for example, a bound volume I once found in a trunk, a book I had never even heard of. It was *The Thousand and One Nights*. I spent the early years of my life haunted by a vision of flying carpets and genies popping out of lamps. It was wonderful . . . and for me, completely true.

Moreover, one of the episodes that excited me most and seemed the most fantastic was perfectly plausible—the story of the fisherman who asks his neighbour to lend him some lead for his net and promises to give her in exchange the first fish he catches. She lends him the lead and he keeps his promise. She cuts open the fish and discovers a diamond inside. Life is full of natural things that ordinary mortals fail to see. The intelligence of poets is to see the extraordinary in the ordinary.

So this is the question I ask myself. Why shouldn't the people who believed in the flying carpets of *The Thousand and One Nights* believe that flying was done in my own village? In my village there are no carpets but there are mats. So people fly mats, and do other wondrous things, among which we grew up and lived. I think I made up my mind not to invent or create a new reality but to find the reality with which I identified and which I knew. That's the kind of writer I am.

■ **What did you do after *One Hundred Years of Solitude*?**

G. G. M.: I began to mistrust myself. I have to make an effort not to repeat or plagiarize myself. I have to go deeper and deeper into reality, by paying special attention to words. Without realizing it, I have a tendency to repeat things and put the same adjectives with the same nouns.

Gabriel García Márquez

The writer's craft

Roberto Grazioli Grazia Neri © Sygma, Paris

People often talk about the influence that some authors have had on others. For myself, I've never tried to imitate authors I've admired. On the contrary, I've done all I could not to imitate them. But in wanting to be personal there is a danger of falling into the opposite trap, and the problem is how to avoid imitating oneself.

In my latest novel, *Del amor y otros demonios* ("Of Love and Other Demons")—a story that takes place in Cartagena de Indias in the eighteenth century—I tried to recreate the culture, the mentality and the intolerance of the period, but the hardest thing of all was to make sure that the novel was different from its predecessors. The first people who read it thought it had a kind of sobriety that wasn't my style. I was delighted because that's what I'd been aiming at, to distance it not from myself but from my other books. It had to he mine; all books resemble their authors. In one way or another every book is autobiographical. And every fictional character is an alter ego or a collage made from this or that aspect of the author, his memories and his knowledge. It seems to me that a writer's work develops as a result of digging down inside oneself to see what is there, for the key to what one is looking for and the mystery of death. We know that the mystery of life will never be deciphered.

■ Is this preoccupation unique to Latin American literature?

G. G. M.: It's a fact that Latin America was born out of a very specific literature, the literature of chivalry. This was no accident since novels of chivalry were banned in the Spanish colonies. They liherated the imagination! Because of these novels, the chroniclers of the conquest were ready to believe what they saw. But what they saw went beyond what they were capable of believing. This led to the birth of the fantastic world which later came to be called "magic realism" and which is a hallmark of Latin American culture.

■ When you think of your public now, do you think in terms of Latin America, the Spanish-speaking world or the world at large?

G. G. M.: First of all we have to win over our own public. If we manage to do that, it means we have said something valid, and only then will we interest the rest of the world. One doesn't acquire a public by chance. First there has to be an identification with reality that interests this public. Then the identification spreads, and it interests the entire world.

Above all we must do and continue to do what we think we should do. Then things start to happen. When I began writing, I never imagined I would have any readers, not to mention large numbers of them. *One Hundred Years of Solitude* was my fifth book. It was five years before my first one was published. It went from publisher to publisher, from press to press. It finally came out, but it was a long time before it began to sell. You have to do your own work, then wait and see. To be able to live from one's writing is a stroke of luck. It can't be a goal.

■ For you as a writer, have there been new departures, moments of doubt, changes of direction?

G. G. M.: I have made two big leaps in the dark. The first was to stop smoking cigarettes. Or perhaps I should say that cigarettes stopped smoking me. I was totally hooked and smoked four packs a day. I never had bronchitis, and the doctor never ordered me to stop. But one day I put out a cigarette and never smoked again. Then, when I sat down to write, I realized that I had never written a line without smoking a cigarette. "Now what?" I wondered. Should I wait and get used to writing without smoking or sit down immediately and start to write? The need to write proved stronger, and I sat down in front of my typewriter. But then another problem cropped up: my hands. They got in the way now that they had no cigarette to hold. Fortunately my mind wasn't affected. It got on with the job as before.

The second leap in the dark happened when I woke up one day and realized I had only one thing to do, and that was to write. Before that I either had to write or work—for television, advertising or the radio. My wife, Mercedes, once put it like this, "What are you doing today, working or writing?" We had separated "work", which had a financial purpose, from "writing", which was an unproductive pleasure. Then, one day I woke up and said to myself, "From now on I don't have to 'work' any more. I can write or not write." But I soon understood the danger this freedom brought. If I didn't write that day, perhaps I wouldn't write tomorrow, or the day after. I kept on writing.

Then I was confronted by another problem. I had always been a newspaperman, and at that time papers were put together at night. It was a bohemian life: finish at the paper at one in the morning, then write a poem or a short story until about three, then go out to play skittles or have a beer. When you got home at dawn, ladies who were

'Writing is a craft, a difficult craft that requires a lot of concentration and discipline'

Roberto Grazioli Grazia Neri © Sygma, Paris

going to mass would cross to the other side of the street for fear that you were either drunk or intending to mug or rape them. Shifting from night to day in order to write wasn't easy.

With my newfound freedom, I made myself keep banker's hours, or rather a bank clerk's hours, as if I had to turn in on time every day. Starting at one specific time and finishing at another. This is important. If you get involved and don't stop in time, the later pages are written by a tired man. The big problem for most writers who don't earn enough to be able to write full time is that they write in their spare time, in other words when they are tired. This is literature produced by tired men. When I get carried away and continue beyond the time when I should stop, I end up by writing tired. You need strict discipline, starting and stopping at specific times.

My children's school started at 8 a.m. I was the one who took them. Then I would sit down and write until two when I brought them back home again. I felt that in all good conscience I had earned my day—and my lunch. In the afternoon I'd go to the cinema or see friends or do various odd jobs. Without feeling guilty.

I felt guilty between books. When I finished one book, I wouldn't write for a while; then I had to learn how to do it all over again. The arm goes cold; there's a learning process you have to go through again before you rediscover the warmth that comes over you when you are writing. So I really had to find something that would keep me writing between books. I solved the problem by writing my memoirs. Since then, I haven't left my desk for a single day. When I travel I'm a little less strict, but I always jot down notes in the morning.

All of which means there is a lot of truth in the saying that writing is one per cent inspiration and 99 per cent perspiration.

I also defend inspiration, but not in the sense given to it by the romantics, for whom it was a sort of divine illumination. When you are working hard on something, trying to make sense of it, worrying at it, fanning it into a blaze, you reach a point where you control it and identify with it so completely that you feel that a divine wind is dictating it to you. That state of inspiration exists, yes, and when you experience it, although it may not last very long, it is the greatest happiness that anyone could possibly experience. ■

'When you are working hard on something, trying to make sense of it, worrying at it, fanning it into a blaze, you reach a point where you feel that a divine wind is dictating it to you'

THE UNESCO COURIER

49th YEAR
Published monthly in 30 languages and in Braille by Unesco, The United Nations Educational, Scientific and Cultural Organization.
31, rue François Bonvin, 75732 Paris CEDEX 15, France.
Fax: (33-1) 45.66.92.70
Internet: unesco.courier@unesco.org

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Subscriptions: Marie-Thérèse Hardy (Tel. 45.68.45.65), Jacqueline Louise-Julie, Manichan Ngonekeo, Michel Ravassard, Mohamed Salah El Din (Tel. 45.68.49.19)
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SUBSCRIPTIONS. Tel.: 45.68.45.65
1 year: 211 French francs. 2 years: 396 FF.
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IMPRIMÉ EN FRANCE (Printed in France)
DÉPOT LÉGAL: C1 - FÉVRIER 1996
COMMISSION PARITAIRE N° 71844 - DIFFUSÉ PAR LES N.M.P.P.
Photocomposition, photogravure: Le Courrier de l'Unesco.
Impression: MAURY IMPRIMEUR,
Z.I. Route d'Étampes, 45331 Malesherbes
ISSN 0041-5278 N° 2-1996-OPI-96-545 A

This issue comprises 52 pages and a 4-page insert between pages 2-3 and 50-51.

SATELLITE NEWS EXCHANGE IN FORMER YUGOSLAVIA

The first exchange of news by satellite between three television stations in former Yugoslavia began on 6 October 1995. Each week since then NTV 99 (Sarajevo), Studio B (Belgrade) and Kanal A1 (Skopje) have been sending their news bulletins to the Worldwide Television Network (WTN) in London, where they are compiled into a thirty-minute copyright-free report (10 minutes per channel). WTN transmits the report every Friday at 16:50 GMT on its Eutelsat II F1 satellite channel, which broadcasts to Scandinavia, Eastern Europe, Syria, Turkey and North Africa. The exchange programme, which has financial support from Unesco, is the latest in a series of Unesco moves to encourage media independence in former Yugoslavia. ■

PALMYRA AND CONFUCIUS

The archaeological site of Palmyra (Syria) and the Chinese philosopher Confucius are featured on two new medals from Unesco's Philatelic and Numismatic Programme. Struck in gold, silver and bronze at the Paris Mint, the medals have been issued respectively within the framework of Unesco's programme to preserve the world's cultural and natural heritage and on the occasion of the fourth World Conference on Women held in Beijing (China) in September 1995. ■

UNESCO PRIZES FOR SCIENCE AND THE ENVIRONMENT

Unesco prizes for science and the environment were awarded at a ceremony held on 6 November 1995 at the Organization's Paris Headquarters. The 1995 Unesco Science Prize went to Chinese computer expert Xuan Wang, who created the Chinese automatic composition system currently being used in the production of 95 per cent of the books and 99 per cent of the newspapers in China. The 1995 Kalinga Prize for the Popularization of Science was awarded to the Mexican astrophysicist Julieta Norma Fierro Gossman. The Carlos J. Finlay Prize was presented jointly to French biologist Pascale Cossart for her research into listeriosis, and to Belgian biochemist Jan Balzarini for his research into cancer and Aids. The 1995 Javed Husain Prize for Young Scientists went to Mexican chemist Tessy Maria Lopez Goerne. The Sultan Qaboos Prize for Environmental Preservation was awarded to the National Park of Lake Malawi (Malawi). ■

EDUCATION FOR ALL IN VIDEO

A database featuring 151 video tapes devoted to educational projects from 58 countries has been set up as part of a joint Unesco-UNICEF project entitled "Education for All, Making it Work". The tapes may be screened upon request at Unesco Headquarters. A printout of the database, entitled VIDED, is also available upon request. ■

✔ Education Sector Documentation and Information Service of the Basic Edueation Division, Unesco, 7 Place de Fontenoy, 75352 Paris 07 SP, France. Tel.: (33-1) 45 68 10 13.

CORRECTION

In the chronology entitled "Key dates" published in the October 1995 issue of the *Unesco Courier (The United Nations: Why it matters)*, the following entry appeared on page 9: "1950, 21 October: The General Assembly condemns the invasion of Tibet by China."

This information was taken from a book entitled *L'ONU pour quoi faire?* by André Lewin (formerly Deputy Director of the Press and Publications Division of the United Nations), published by Gallimard, Paris, 1995. On page 132 of Mr. Lewin's book, in a chapter entitled "Chronology", the following entry appears: "1950, 21 October: the Chinese army enters Tibet. The Assembly condemns China."

In point of fact, the General Assembly adopted its first Resolution on Tibet on 21 October *1959* (not 1950). Furthermore, this Resolution does not include any *explicit* condemnation.

In our previous issue, *Dance, the sacred fire*, Maurice Béjart was interviewed by Martine Leca.

Month by month

It is the most natural thing in the world to want to simplify things and see them in schematic form, and to break complex phenomena down into their component parts. Surely, before starting to look for order in a chaotic world we should make an effort to set our own minds in order. But though this may be a necessary first step, it can be misleading. If we go no further, if we regard the point of departure as the destination, if we consider as certainties what are at best only approximations, if we mix up the parts with the whole, we adopt a reductionist outlook on the world. And sooner or later a price must be paid.

In politics freedom is one casualty of a reductionist outlook, as twentieth-century totalitarianism has shown on many occasions. Whether it is right-wing or left-wing, religious or secular, rooted in ideology or the expression of an identity, totalitarianism regards one human group—a race, a nation, a class, or a religious denomination—more favourably than all others and systematically highlights the virtues of the former and the defects of the latter. By so doing, it glorifies the collective destiny of the group and denigrates the individual experience of its members. Those who have such a biased, hemiplegic perception of themselves and of others not only end up by doing harm to others but by mutilating themselves.

What can be seen in the social arena also occurs in all the other spheres in which human intelligence is exercised. Oversimplification is always infertile because it imposes a straitjacket of rigidity on what is constantly changing, because it compartmentalizes what is naturally interlinked, and because it is suspicious of the chaotic, contradictory and random elements that are intrinsic to nature.

This approach leads to a dead end and must be superseded by an effort to move from the simple to the more complex, to turn from the study of simple units and examine the complexities of their interactions. For much of the time, most people manage to ignore the science of complexity and rely instead on plain common sense. Now, however, as Edgar Morin says in this issue, non-specialists cannot afford to leave the privilege of complex thought to scientists. We must learn to fathom the mysteries of complexity because the substance of daily life has itself become so complex.

This is a challenge that life in the late twentieth century compels us to accept. If we refuse to do so we may lose the thread of reality and find ourselves victims of new forms of totalitarianism.

BAHGAT ELNADI AND ADEL RIFAAT

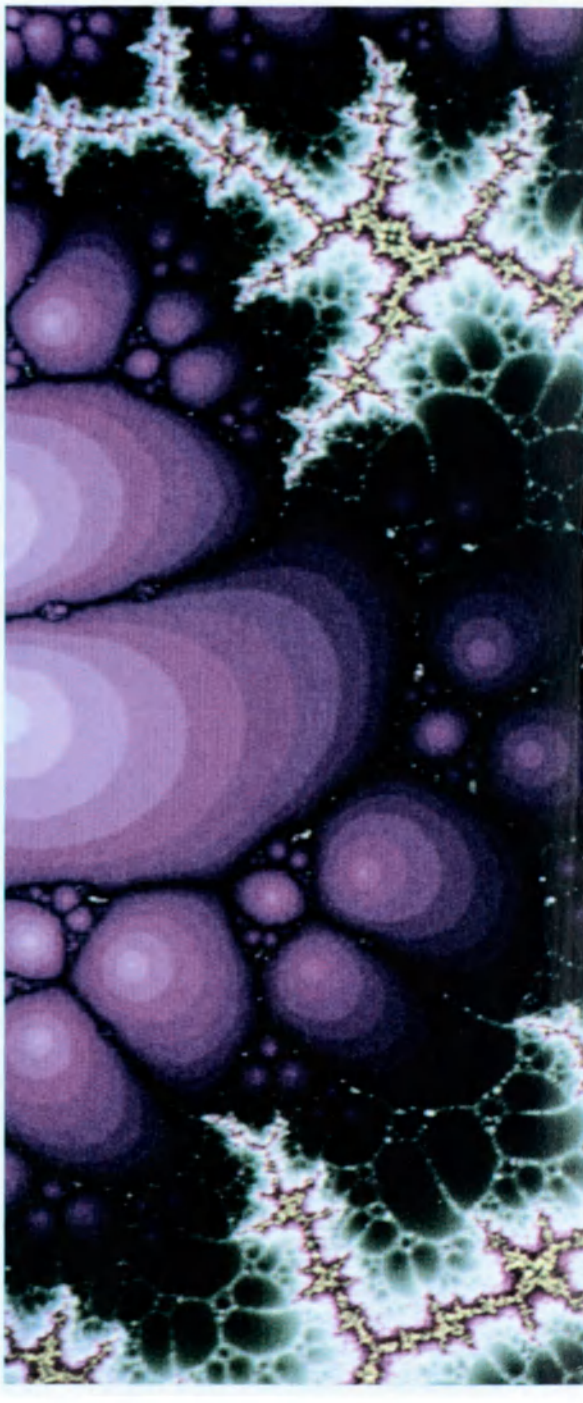
A new way of thinking

by Edgar Morin

© Courrier de l'Unesco, Paris

EDGAR MORIN
is a French sociologist who is emeritus director of research at France's National Centre for Scientific Research (CNRS). He is the author of many published works, including *Introduction à la pensée complexe* ("Introduction to Complex Thought", ESF, Paris, 1990) and recently published a selection of writings entitled *La complexité humaine* ("Human Complexity", Flammarion, Paris, 1994). His most recent work published in English is *Towards a Study of Humankind. Vol 1: The Nature of Nature* (1992).

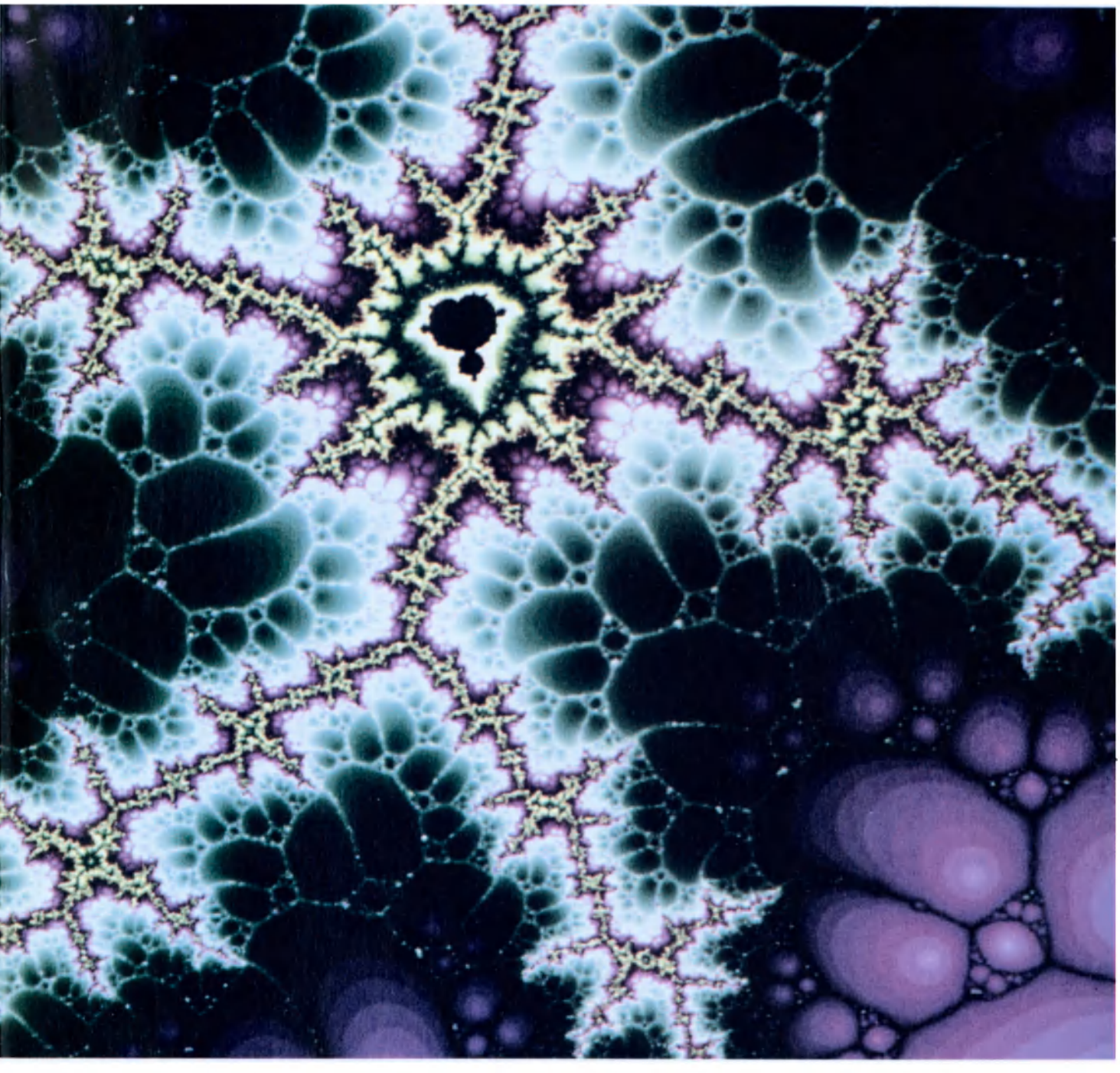
Complexity represents a shift away from the simplifying, reductionist approach that has traditionally shaped scientific enquiry



Until the mid-twentieth century, most sciences based their method on specialization and abstraction, i.e. reducing knowledge of a whole to knowledge of its constituent parts (as though the organization of a whole did not generate new properties in relation to those of its separate parts). Their key concept was determinism, in other words the denial of random factors and new factors and the application of the mechanical logic of artificial machines to the problems of living beings and social life.

Knowledge must make use of abstraction, but it must also be constructed by reference to context and hence must mobilize what the enquirer knows about the world. Individual facts can only be fully understood by those who maintain and cultivate their general intelligence and mobilize their overall knowledge. Admittedly, it is impossible to know everything about the world or to grasp its many and varied transformations. But no matter how difficult this may be, an attempt must be made to understand the key problems of the world, for otherwise we would be cognitive idiots. This is particularly true today because the context of all political, economic, anthropological and ecological knowledge has become global. As a result of globalization, everything must be situated in the planetary context. Knowledge of the world as such is necessary both for intellectual satisfaction and for life itself. Every citizen faces the problem of gaining access to information about the world, and then of piecing it together and organizing it. To do this, a new form of thinking is needed.

In the first place, the kind of thinking that separates must be supplemented with a kind of thinking that makes connections. *Complexus* means "that which is woven together". Complex thought is a kind of thought that unites distinction with conjunction. Secondly, it is necessary to come to grips with uncertainty. The dogma of universal determinism has collapsed. The universe is not subject to



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A computer-generated image created from a fractal geometry formula.

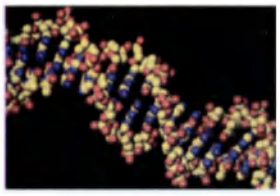
the absolute sovereignty of order; it is the outcome of a "dialogical" relationship (a relationship that is both antagonistic, concurrent and complementary) between order, disorder and organization.

Complexity thus connects (contextualizes and globalizes) and also comes to grips with the challenge of uncertainty. How does it do this?

The three theories

One approach to complexity is provided by three theories—information theory, cybernetics and systems theory. These theories, which are closely related and indeed inseparable, emerged in the early 1940s and have had a far-reaching cross-fertilizing effect on one another.

- **Information theory** gives access to a universe where there are both order (redundancy) and disorder (noise) and derives something new from it, i.e. information itself, which then becomes the organizing (programming) instrument of a cybernetic machine. For example, information that gives the name of the victor of a battle resolves an uncertainty. Information that announces the sudden death of a tyrant introduces an unexpected new element into a situation.
- **Cybernetics** is a theory of self-controlling machines. The idea of feedback, introduced by the U.S. mathematician Norbert Wiener,



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Model of the double stranded helix of DNA (deoxyribonucleic acid), the main constituent of the genetic material of living cells.

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'Complexity connects (contextualizes and globalizes) and also comes to grips with the challenge of uncertainty.'

breaks with the idea of linear causality and introduces that of the causal loop. The cause acts on the effect and the effect on the cause, as in a heating system where a thermostat controls the operation of a boiler. This regulatory mechanism makes the system autonomous, in this case ensuring that an apartment has thermic autonomy from the colder temperature outside. The feed-back loop may act as an amplifying mechanism, e.g. in a situation where an armed conflict reaches a critical stage. The violence of one adversary triggers off a violent reaction which in turn triggers off another, even more violent reaction. Very many instances of this sort of inflationary or stabilizing feedback can be found in economic, social, political or psychological phenomena.

● **Systems theory** provides the basis of a way of thinking about organization. The first lesson of systems analysis is that "the whole is more than the sum of its parts". This means that properties emerge from the organization of a whole and may have a retroactive effect on the parts. For instance, water is an emergent property of the hydrogen and oxygen of which it is composed. The whole is also less than the sum of its parts, since the parts may have properties that are inhibited by the organization of the whole.

Self-organization

In addition to these three theories are a number of conceptual developments related to the idea of self-organization. Four names that must be mentioned in this context are those of John von Neumann, Heinz von Foerster, Henri Atlan and Ilya Prigogine.

In his theory of automata, von Neumann considered the difference between artificial automata and "living machines". He pointed to the paradox whereby the components of artificial machines, although very well designed and engineered, deteriorate as soon as the machine starts to operate. Living machines, on the other hand, are made of extremely unreliable components, such as proteins, which are constantly subject to deterioriation. However, these machines have the unusual property of being able to develop and reproduce themselves; they regenerate themselves through replacing damaged molecules by new molecules, and dead cells by new cells. An artificial machine cannot repair itself, whereas a living machine constantly regenerates when its cells die. It is, as Heraclitus put it, "life from death and death from life".

Von Foerster's contribution is his discovery of the principle of "order from

'Order, disorder and organization are constantly interacting in the physical, biological and human worlds.'

noise". If a box containing a haphazardly arranged collection of cubes, each magnetized on two faces, is shaken, the cubes spontaneously form themselves into a coherent whole. A principle of order (magnetization) plus disordered energy have created an ordered organization. In this way, order is created from disorder.

Henri Atlan has developed the theory of "random organization". At the birth of the universe there was an order/disorder/organization dialogic triggered off by calorific turbulence (disorder), in which, under certain conditions (random encounters) organizing principles made possible the creation of nuclei, atoms, galaxies and stars. This dialogic recurred when life emerged via encounters between macro-molecules within a kind of self-productive loop which eventually became a living self-organization. The dialogic between order, disorder and organization exists in a wide variety of forms, and via countless feedback processes is constantly in action in the physical, biological and human worlds.

Prigogine introduced the idea of self-organization from disorder in a different way. In so-called Rayleigh-Bénard convection cells, coherent structures are formed and maintened between two temperature levels when a thin layer of silicone oil is carefully heated. In order to be sustainable, these structures need supplies of energy which they consume and dissipate. Living beings have sufficient autonomy to draw energy from their environment and even extract information from it and absorb its organization. I have called this process auto-eco-organization.

The study of complex phenomena can thus be seen as a building with several floors. The ground floor consists of the three theories (information, cybernetics and systems) and contains the tools needed to develop a theory of organization. On the second floor are the ideas of von Neumann, von Foerster, Atlan

Left, "*Complexus* means 'that which is woven together'." Below, "The universe is the interplay of an antagonistic and complementary relationship between order, disorder and organization."

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Louvre Museum © Lauros Giraudon, Paris

***Springtime* (1573) by the Italian painter Giuseppe Arcimboldo.**

and Prigogine on self-organization. I have added some other features to the building, notably the dialogical principle, the recursion principle and the hologrammatic principle.

The three principles

The dialogical principle brings together two antagonistic principles or notions which on the face of things should repel one another but are in fact indissociable and essential for understanding a single reality. The physicist Niels Bohr believed that physical particles should be regarded as both corpuscles and waves. Blaise Pascal said that the "the opposite of a truth is not an error but a contrary truth." Bohr put this in the following terms: "The opposite of a trivial truth is a stupid error, but the opposite of a profound truth is always another profound truth". The problem is that of combining antagonistic notions in order to envisage the organizational and creative processes in the complex world of human life and history.

The principle of organizational recursion goes further than the feedback principle; it goes beyond the idea of regulation to that of self-production and self-organization. It is a generating loop in which products and effects themselves produce and cause what produces them. Thus we, as individuals, are the products of an age-old system of reproduction, but this system can reproduce itself only if we ourselves become its producers by procreating. Individual human beings produce society in and through their interactions, but society, as an emerging whole, produces the humanity of individuals by conferring language and culture on them.

The "hologrammatic" principle highlights the apparent paradox of certain systems where not only is the part present in the whole, but the whole is present in the part: the totality of the genetic heritage is present in each individual cell. In the same way, the individual is part of society but society is present in every individual, through his or her language, culture and standards.

Conclusion

Thinking in terms of complexity is clearly not a mode of thought that replaces certainty with uncertainty, separation with inseparability, and logic with all kinds of special exceptions. On the contrary, it involves a constant toing and froing between certainty and uncertainty, between the elementary and the global, between the separable and the inseparable. The aim is not to abandon the principles of classical science—order, separability and logic—but to absorb them into a broader and richer scheme of things. The aim is not to set a vacuous all-purpose holism against systematic reductionism, but to attach the concreteness of the parts to the totality. Linkage must be made between the principles of order and disorder, separation and connection, autonomy and dependence, which are at one and the same time complementary, concurrent and antagonistic.

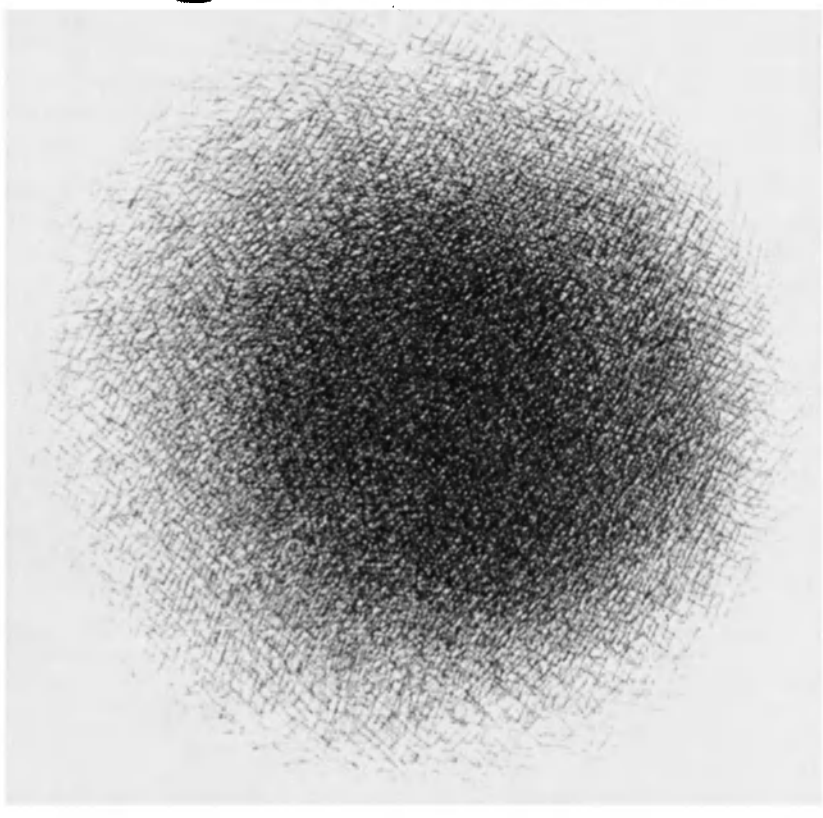
In short, complex thought is not the opposite of simplifying thought; it incorporates simplifying thought. As Hegel might have put it, it unites simplicity and complexity and ultimately reveals its own simplicity. In fact, the paradigm of complexity can be described just as simply as that of simplicity. Whereas the latter requires us to dissociate and reduce, the paradigm of complexity requires us to connect as well as to distinguish.

Complex thought is essentially thought which incorporates uncertainty and is capable of conceiving organization. It is capable of linking, contextualizing and globalizing but can at the same time acknowledge what is singular and concrete. ■

'Complex thought incorporates uncertainty and is capable of conceiving organization.'

A family tree with roots in East and West

by Yi-zhuang Chen



From Lao-tzu to Hegel, thinkers from different cultural horizons point the way to complex thought

Complex thought has a long history, which can be traced in both Western and Chinese philosophies.

From Heraclitus to Lao-tzu

Some philosophers of Western Antiquity argued that reality is complex but thought is simple, and that if people did not realize this, the essence of reality would escape them altogether. For instance, the properties of being, which are contradictory and incompatible according to the categorizations of human thought, may be in harmony and simultaneous in real life. This was the key idea of the Greek philosopher Heraclitus (535-480 B.C.), who taught people "to listen to nature" in order to find its "invisible harmony". "Union consists of bringing together and tending apart, agreement and disagreement; the One comes out of all things and all things out of the one."

"By virtue of its dynamism, the mind, like the self-organizing being, resists natural tendencies to chaos and degradation." Above, *Labyrinth* (1993), Indian ink drawing by the Argentine artist Christina Martínez.

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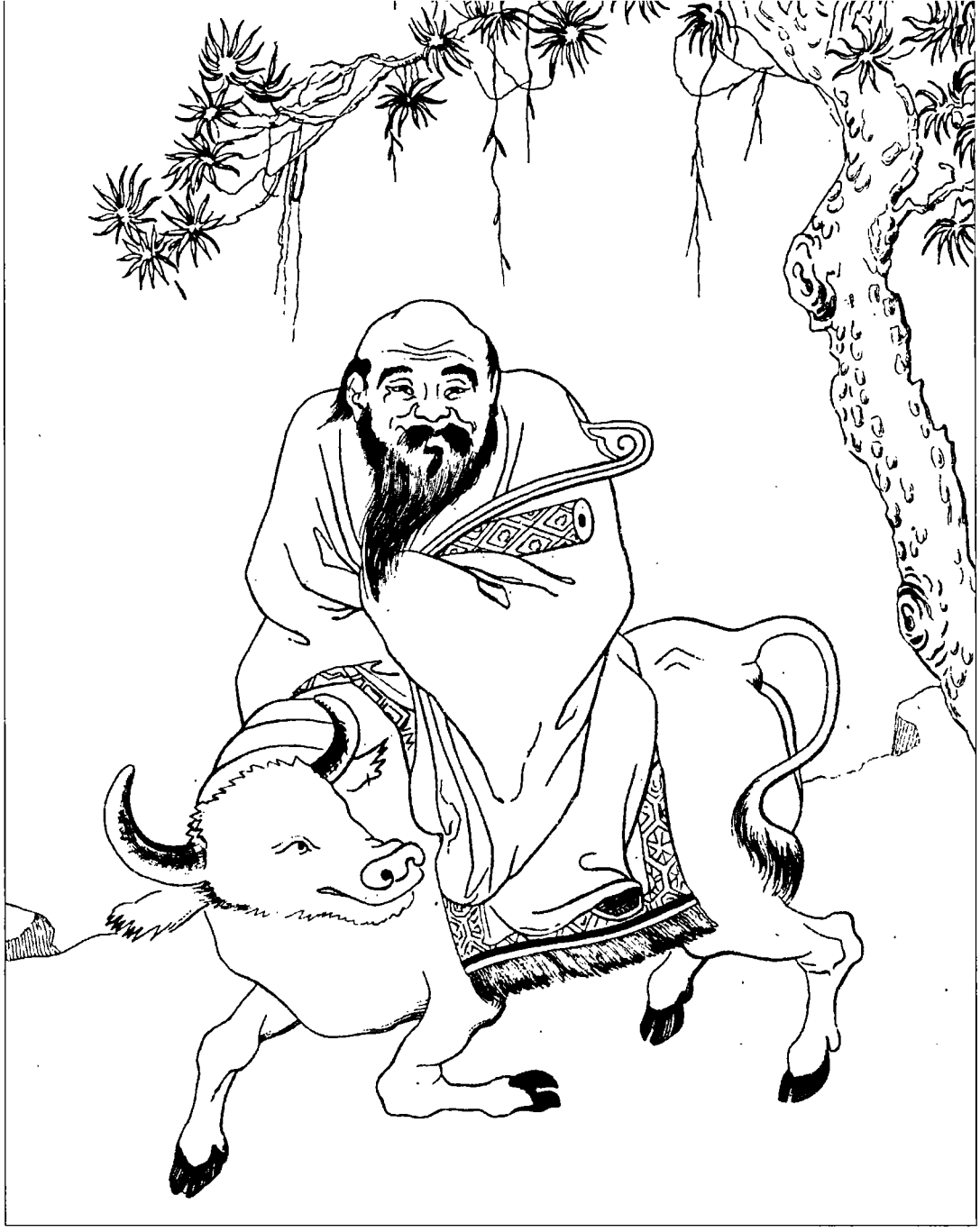
According to Heraclitus, the underlying connection of opposites—the transformation of a thing into its opposite—is the principle of the *logos*, the universal formula in accordance with which all natural events occur. But this concept is difficult to grasp owing to the fixed, one-sided nature of human intelligence.

Similar ideas appeared at a very early stage in Chinese philosophy. In the *I Ching* ("Classic of Changes") dating from the eleventh-twelfth centuries B.C., *yin* and *yang* constitute the two opposite poles of a single reality, its fundamental duality. In its original sense, *yang* meant the brightness of the sun or a sun-bathed slope, while *yin* meant lack of brightness, or a shady slope. Later, all phenomena came to be classified in terms of *yang* and *yin* and to be regarded as comprising two opposing aspects. As efficient causes, *yin* and *yang* co-operate to produce the universe and all its constituent parts and to regulate their

'In proposing a many-sided version of the truth, Protagoras points to the dimension of thought that cannot be simplified.'



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The 4th-century-B.C. Chinese philosopher Lao-tzu, the father of Taoism.

movement. As the *I Ching* puts it, "*Yang* is the principle that makes things commence, while *yin* is that which completes them".

The ancient Chinese believed that the cosmos is governed by a bipolar principle and cannot be reduced to a single ultimate principle. Thought is governed by the proposition that opposites are exclusive and incompatible, but real life is governed by the complementarity of opposites. In the *Tao-te Ching* (the "Classic of the Way of Power"), Lao-tzu (fourth century B.C.) explains that "the movement of *tao*," which is at the origin of the universe and causes order to reign within it, is "to act in the opposite direction".

The *tao* encourages what is underdeveloped and represses what is overdeveloped. This leads to the implacable law whereby everything that has developed to its extreme turns into its opposite. "People who have grown robust, age", for example. This law maintains the harmony of the world as an organic whole, but it often goes against the will and the spontaneous intelligence of human beings. By claiming that the successful completion of an enterprise means starting out from its opposite, Lao-tzu brings to light a multitude of paradoxical phenomena and criticizes the linear nature of human understanding.

Protagoras and Chuang-tzu

Philosophical relativism, which in the West was introduced by the Greek sophist Protagoras (485-441 B.C.), takes account of the multiplicity of approaches which are the basis of knowledge. While "matter" is the common source of human sensations, the images human beings have of matter are determined

by their senses, which change with age and the constitution of their bodies, so that each of us sees matter in a different way. However, no one representation of the true physiognomy of matter is superior to any other. There are as many yardsticks for measuring things as there are people to measure them.

Plutarch tells the story of an athlete who died of a wound inflicted by a javelin during a sporting contest. After the accident, the Athenian statesman Pericles and Protagoras spent a whole day discussing who or what was responsible for it, the javelin, the javelin thrower or the organizers of the event. The philosopher maintained that it was necessary to distinguish several different viewpoints: for a doctor, the javelin was the direct cause of death; for a judge, the javelin-thrower was responsible; from the viewpoint of a magistrate, the organizers of the contest should be charged.

In proposing a many-sided version of the truth, Protagoras is advocating that diversity and contradiction should be tolerated and even legitimized in the process of knowledge. He points to the unsimplifiable, irreducible dimension of thought.

These ideas also have an equivalent in Chinese thought. In the view of Chuang-tzu (c. 369-268 B.C.), people apprehend different aspects of the same object, depending on their standpoint. This observation prompted him to relativize the truth. "The male monkey seeks the female," he wrote. "The stag seeks the hind. Moaqiang and Liji are beautiful creatures whom all men adore, but when they approach, fish dive deep into the water and birds fly quickly away. Who knows true beauty?" Human knowledge is conditioned and is therefore uncertain.

Kant and Hegel

In modern times, philosophers began to realize that the human mind is capable of both simple thought, which abides by the rules of

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The Greek philosopher Heraclitus of Ephesus (6th-5th centuries B.C.).

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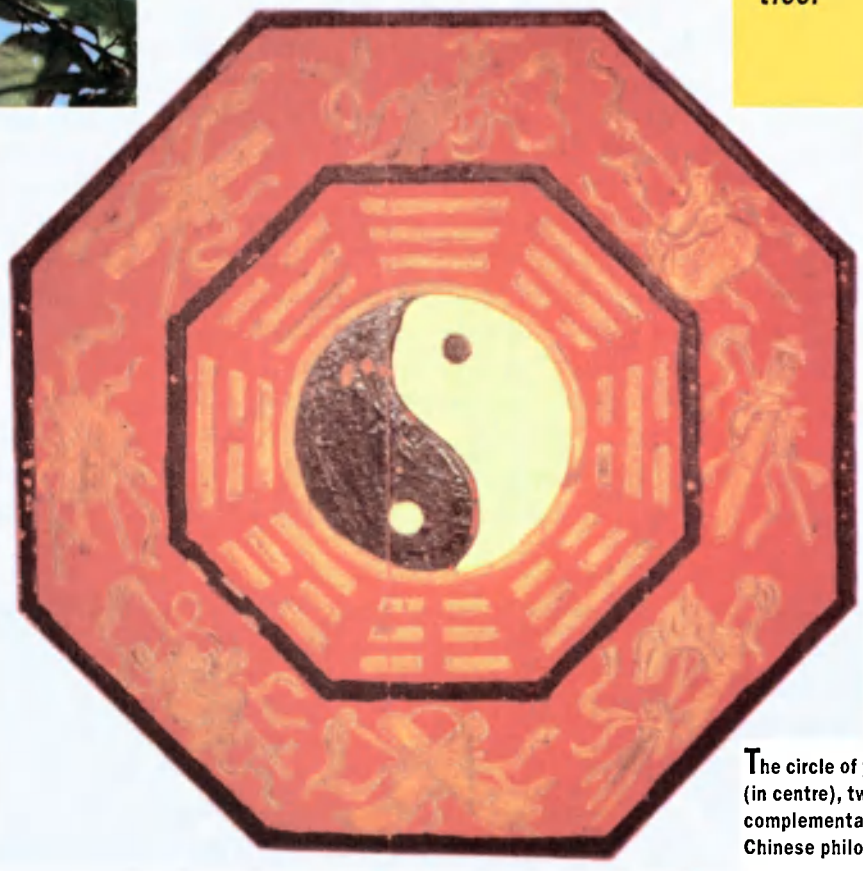
Flowers and fruit of a paulownia, a tree originating in China.

'The root, which is at the origin of the tree, comes from the seed, which is itself born of the tree.'

Fang Yizhi



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The circle of yin and yang (in centre), two complementary principles of Chinese philosophy.

'Moaqiang and Liji are beautiful creatures whom all men adore, but when they approach, fish dive deep into the water and birds fly away. Who knows true beauty?'

Chuang-tzu

formal logic, and complex thought, which goes beyond those rules and criticizes, corrects and improves simple thought. The mind has the power to criticize itself and improve itself. It is capable of knowing the complexity of reality, and also of knowing itself.

Immanuel Kant (1724-1804) held the view that understanding is concerned with knowing the relative (or the finite) and reason with knowing the absolute (or the infinite). However, the distinction he makes between these two cognitive faculties prevents him from arriving at a true paradigm of complexity. G.W.F. Hegel (1770-1831) combined the two by making a distinction between three levels in the human mind: understanding, which is responsible for analytical knowledge and separates concepts; negative or dialectic reason, which is concerned with synthetic knowledge and unites all concepts by removing the difference that divides them; and positive reason, which unites analytical and synthetic knowledge and grasps that all concepts are distinctive yet linked, and certain by virtue of their mobility. These three cognitive levels are also essential and are organically welded into a single process. We thus have a perfect process, capable of self-perfection.

In Hegel's view, the movement of the mind follows an ascending loop. It emerges from its usual form of operation (understanding) in order to reveal the limits of that form and remedy its failing, and then returns with all the results of its criticism and correction (dialectic) to its usual form of operation, but at a higher level.

The active nature of the mind brings it closer to the self-organizing being which, by virtue of its dynamism, resists natural tendencies towards chaos and degradation. The paradigm of complexity thus unveils the

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Japanese snow monkeys.

essential way in which our mind functions, while providing us with the means of understanding the workings of reality, of the self-organizing and self-producing being.

Fang Yizhi

A century and a half before Hegel, the Chinese philosopher Fang Yizhi (1611-1671) had formulated very similar ideas. Deeply influenced by the dialectic arising from Chinese philosophical tradition and Indian Buddhism, Fang Yizhi argued that two fundamental methods of knowledge existed simultaneously: the "investigation of qualities" (identifying the specific determinants of different things) and the "embracing of the essence" (finding the common cause that determines different things).

According to Fang Yizhi, only through the fusion of these two methods (analytic and synthetic) is it possible to know dynamic reality. The essence of the real is to be found in self-determination and self-creation. He takes the example of the tree. The root, which is at the origin of the tree, comes from the seed, which is itself born of the tree. Once the tree has flowered, the seed is no longer its substance (*ti*) but its mode of operation (*yong*). The functioning of a thing has a causality that is not linear but recursive.

Fang Yizhi's methodology is based on the theory of the threefold truth which he took from Buddhism. He believed in the paramount need to affirm the existence of two opposing extremes (Heaven and Earth, for example) and of all the distinctive things of the world of phenomena. The next step is to deny the existence of all this in order to grasp the unitary value of the noumenal world as nothingness. The synthesis of these two forms of knowledge leads to complete and perfect knowledge. In other words, Fang Yizhi first of all observes the principle of non-contradiction and then subjects it to the principle of the unity of opposites, before going on to comply with both principles at the same time, each to its relevant degree. Here once again are Hegel's three cognitive levels: understanding, dialectical reasoning and positive reasoning. ■

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Cutting the Gordian knot

by Ivar Ekeland

Since we can never base our decisions on complete knowledge, we have to live with uncertainty

Human existence is fraught with uncertainty. Who knows what tomorrow may bring? But this does not prevent us from taking daily decisions, in our private and public lives, which hold implications for our future, for the future of our families, our country or even—in certain dramatic situations, such as war—the future of humanity as a whole. These decisions, be they good or bad, are taken on the basis of the information available at the time.

This raises the question of whether bad decisions may not be the result of inaccurate or incomplete information. Would complete knowledge of a particular situation allow a fully-informed decision to be taken and its consequences to be predicted with virtual certainty?

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Mel Gibson in the title role of Franco Zeffirelli's film *Hamlet* (1991).

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The climatological model

The complexity of both natural systems and those of human design means that the ideal scenario—a clear-cut situation leading to a good decision, the effects of which can be simply deduced—is not only unattainable but inconceivable.

An example of such a complex system is provided by that increasingly disturbing climatic conundrum, the greenhouse effect. Does human activity increase the level of carbon dioxide in the atmosphere and, if so, what are the consequences for the earth's climate? From a purely scientific viewpoint, the problem consists in studying the long-term evolution of a complex system (the earth's atmosphere) which is subject to a variety of external influences (cosmic and solar radiation, interactions between the oceans and the land masses, influence of human activity and other life-forms, etc.). The difficulty is twofold: one must first acquire knowledge of the present state of the system and, once this has been thoroughly established, one must then predict its future evolution.

Let us start by examining the apparently

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"A butterfly flapping its wings . . . can unleash a storm. . . "

'In order to predict next year's weather at a given spot one would need a network of information from all over the surface of the globe.'

simple notion of "the atmospheric level of CO_2". Does this mean determining the level of CO_2 at a particular point in the atmosphere? This requires a statistical analysis which reveals certain major seasonal trends but leaves a substantial margin of error, due to the uncertainty of various meteorological variables. Or does it rather mean, less arbitrarily, the total mass of CO_2 present in the atmosphere at a given point in time? There is no way of measuring this directly and, in any case, there is no indication that this approach would be any less uncertain than the previous interpretation.

The only precise definition of this parameter would be "the level of CO_2 at every point in the atmosphere at any given moment". For this definition to be operational, it would have to be supplemented by a mass of data on the direction and strength of the wind, the temperature and humidity of the air, and on the oceans. Only then could we determine, more or less precisely, the near future of the climatic system.

A definition which requires such a volume of information is barely feasible in economic terms. It is therefore right to wonder whether we should not abandon the attempt to produce a single figure to denote this persistently elusive quantity, the "atmospheric level of CO_2". Would it not be sufficient to work on the basis of typical figures, for example, from points at intervals of 100 km across the earth's surface, and at 5,000 m intervals of altitude?

The answer naturally depends on precisely what we are looking for. In meteorology, this kind of precision would enable forecasts to be made from one day to the next. To forecast the weather two days ahead, data must be gathered on a finer scale; and the farther ahead we wish to see, the more sensitive and extensive the data base must be. The American meteorologist Edward Lorenz has remarked that a meteorological disturbance which is allowed to develop unhindered may double in magnitude within three days. In the now famous image, a butterfly flapping its wings in the Amazon basin can, if atmospheric conditions are favourable, unleash a storm on the coast of Brittany a year later.

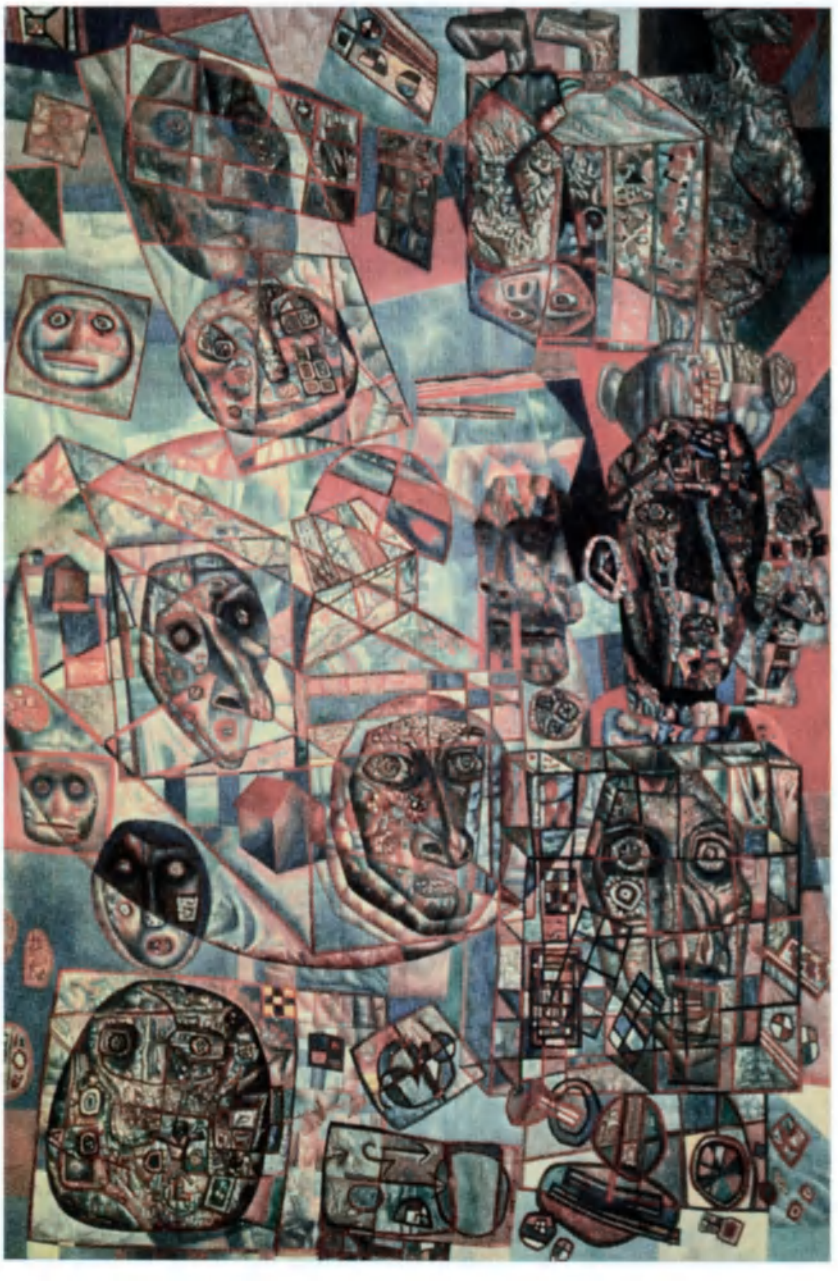
In other words, in order to predict next year's weather at a given spot one would need a network of information on the scale of the butterfly, stretching all over the surface of the globe.

'Modern societies have become so complex that their situation can no longer be encapsulated in a handful of figures.'

Let us now leave the domain of meteorology, with its short-term quantitative predictions, and return to climatology, where these phenomena are analysed qualitatively over a much longer time-scale. Can we achieve results using composite data, by considering the "atmospheric level of CO_2" as a mean annual value adjusted to take account of random fluctuations? This is possible, but it will not guarantee a significant improvement in the degree of certainty of our predictions. One can, of course, imagine large-scale assessments of the thermodynamics of the atmosphere, which would enable definite conclusions to be drawn. The dynamics of the earth's atmosphere are subject to great variation from one year to the next, but a statistical analysis over a longer period—a century, say—would reveal certain trends

However, the relatively short history of climatology means that such analyses are not available to us at present. In any case, it could be that the atmospheric level of CO_2 in 100 or 200 years time may crucially depend on phenomena that are too subtle or too obscure to have yet entered our calculations (for example, the disappearance of certain animal species).

***Man in the World*, oil on canvas by the Russian painter Pavel Filonov (1883-1941).**



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A stitch in time

The question of the accumulation of large amounts of data crops up in most human systems (economics, politics, the social sphere, etc.). It was long believed that the state of the economy, and public opinion, were dependent on several major variables (including the rate of inflation, unemployment, taxation and the balance of trade) and that the art of government consisted in maintaining these few indicators within acceptable limits, or bringing them back into line if they strayed beyond these limits.

In recent years, however, some industrialized countries have been unable to reduce their unemployment figures; and a President of the United States suffered a severe electoral defeat during a period of economic growth. It may therefore be wondered whether we tend to represent problems in an over-simplistic manner, and whether statistical data still have any value at all. Perhaps modern societies have become so complex that the reality of a given situation can no longer be encapsulated in a handful of figures, still less be controlled on such a basis.

In any event, we can be certain of one thing in human affairs: that nothing is certain. One might even wonder whether certainty is desirable. To want to know everything about a given subject is futile, an endless escalation into complexity. As Shakespeare's Hamlet knew, any decision involves slicing through a Gordian knot. Complete information will never be available, and total certainty is impossible. But there always comes a moment when one must decide, when the search for further information is more of a hindrance than a help. Certainty will not be forthcoming, either sooner or later, and we will never know for sure whether we have made the right decision: a world in which a different decision had been taken, a world in which Chancellor Helmut Kohl, for example, had not gone ahead with the reunification of Germany, would be so different from the world we know that any comparison between the two is meaningless.

One could almost say that the most important skill in decision-making is knowing when to decide. ■

Dragon Fly (1993-1994), a watercolour by Diana Ong.

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Frontiers of psychotherapy

Psychotherapy has invented new forms of dialogue

by Saúl Fuks

SAÚL FUKS,
an Argentine psychologist, is director of the research institute of the faculty of psychology at the University of Rosario, where he teaches a specialist course in clinical psychology for postgraduate students.

Psychotherapy that takes account of complexity must be based on a form of dialogue that enables those involved to question their convictions and dare to explore new approaches to reality.

This means that the psychotherapist must agree to come down from his or her pedestal. If psychotherapists really want their patients to rediscover the capacity to assume responsibility for their lives, they must reject the position of power their patients attribute to them at the outset.

The therapeutic relationship tends to function according to a socio-cultural pattern in which the psychotherapist is regarded as the heir of the shaman, the healer or the sage—as a person with special powers associated with a vast and diffuse corpus of knowledge.

'Psychotherapists have had to become explorers of the unknown territories of existence.'

The state of desperation and extreme vulnerability that induces people to consult a psychotherapist makes them extremely receptive to the image of the therapist as an omniscient person with unlimited powers to cure mental suffering.

Because people who suffer in this way feel weak, they tend to entrust themselves fully to the psychotherapist, who is regarded as someone who can answer all their questions (and thus, they hope, solve all their problems).

The only way to modify the balance of power between the person who has all the knowledge and the person who has none is to redefine psychotherapy and first of all what society expects from the psychotherapist.

A co-operative relationship

Long before psychotherapy became a profession, a variety of practices existed to put right those who "deviated" from the social norm, either by going too far (agitation, manic states, madness) or not far enough (loss of contact, unsociability, inertia).

"Madness" and "delinquency" are the terms society uses to describe these deviations from the line it considers to be "normal" at a given moment in its history. A penal system and a security apparatus exist to take steps against delinquency; machinery for control and isolation exists to deal with madness. On the other hand, society makes allowances for those it regards as "visionary" or "inspired" people whose ways of life are accompanied by certain deviant forms of behaviour.

In the 1960s questions began to be asked about the power relationships that exist in psychotherapy, paving the way for exploration of other aspects of the therapeutic relationship.

This relationship gradually ceased to be considered as a contract between a professional possessing a specific body of knowledge and a patient ready to accept and absorb that knowledge, but rather as the confrontation of two different, but equally valid, types of knowledge. These forms of knowledge may or may not coincide, but their degree of convergence or divergence does not affect the idea that the therapeutic relationship is by nature co-operative.

This approach has led to a transformation of the roles, identities, practices, context and forms that exist in this type of relationship. Today, those involved in psychotherapy are no longer simply people telling a story, true or false as the case may be, but have become architects of their own lives.

The complexities of psychotherapy

This new approach to the alleviation of psychological distress has naturally transformed the possibilities and the operational capacity of psychotherapy.

Crises, troubles and disorders are no longer considered as "risk situations" but as "fields of possibility". This being so, a rich array of intensely felt choices, decisions, and hesitations between "future and possible" worlds comes into play and obliges psychotherapists to invent new forms of dialogue.

***Medicine Man* (1994), an acrylic painting by the American artist Gayle Ray.**

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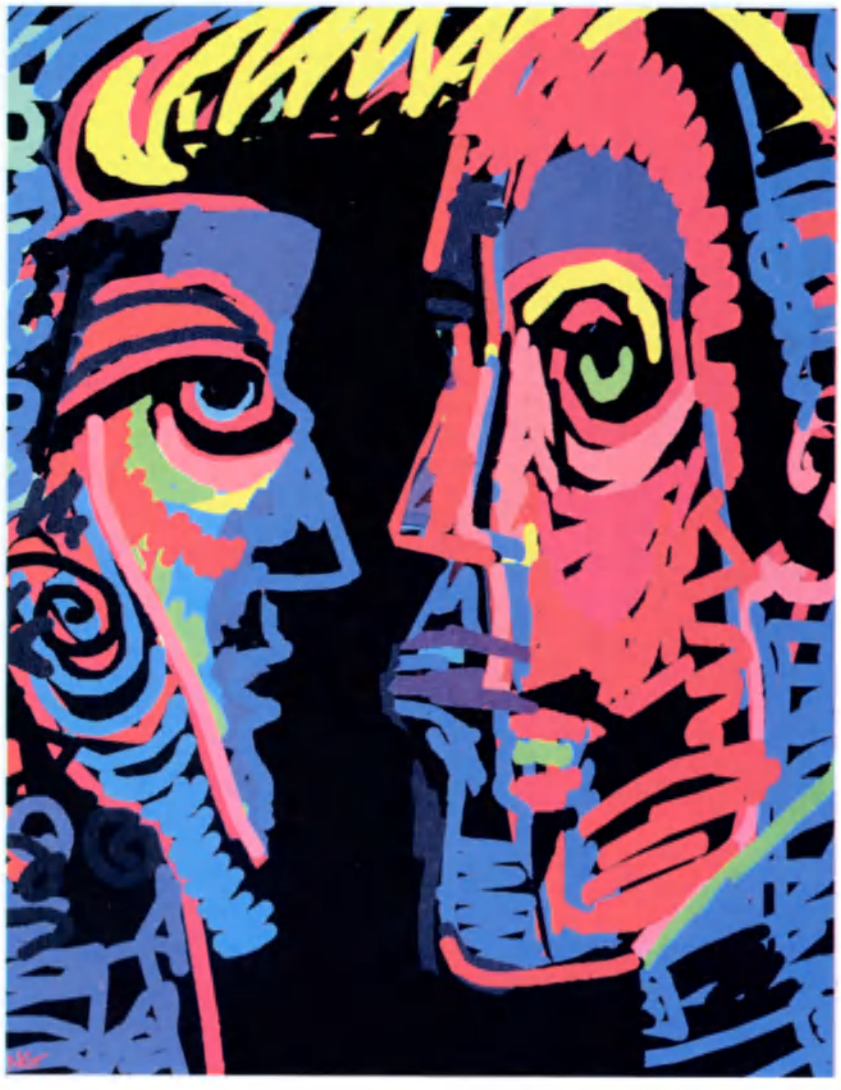
'The idea that each of us is the sum of multiple identities makes it possible for both therapists and their patients to use all the multidimensional aspects of their personalities.'

When their inherent complexities are taken into account, deviant symptoms and forms of behaviour become part of a contextual dynamic based on language. Verbal exchanges bring into play factors large and small, subjectivity and intersubjectivity, and all the building blocks of reality available to the protagonist and to the person who is seemingly a mere observer.

Before it began to explore these different ways of being and their contexts, psychotherapy first had to re-examine the function of "social control". This meant that therapists had to abandon the role whereby they made a diagnosis based on a system of theoretical knowledge and become explorers of the unknown territories of existence. They had to use their ignorance and their capacity for surprise, in order to explore the mysteries of what seems "obvious", "natural", and "common knowledge".

This joint construction of a shared reality involved the creation of new mechanisms: a form of dialogue in which the questions are more important than the answers; an atmosphere of co-operation conducive to the exploration of possible futures and ways leading to them.



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"Two equally legitimate forms of knowledge, which may or may not coincide". Above, *Two Men* (1993-1994), a watercolour by Diana Ong.

"Verbal exchanges bring into play the building blocks of reality. . . ." Below, a computer-generated image (1994) by Frank Collyer.

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The "essentialist" approach whereby persons are considered as possessors of *an* identity was based on the coherence and permanence of a uniform "mode of existing". The idea that each of us is the sum of *multiple* identities, on the other hand, makes it possible for both therapists and their patients to use all these complex and multidimensional aspects of their personality.

This is not a purely theoretical question: multiple identities also define our possibilities and limits in the worlds of the emotions, the intellect and action. What people allow or refuse to allow themselves to think, feel and do is closely linked to the structure of their identities and to the degree of flexibility, creativity and reflection that it allows, and to their possibilities of further development.

Psychotherapy has become a field in which all those involved can explore and discover their resources in order to redefine their lives. ■

The case of the disappearing dinosaurs

by Gianluca Bocchi and Mauro Ceruti

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"Is evolution the result of a pre-established scenario or a chain of fortuitous events?"

The earth's natural history has known many a chapter of accidents

Why did the dinosaurs disappear? This question has intrigued human imagination ever since the first fossils of these enormous prehistoric animals related to the reptiles were discovered nearly two centuries ago.

Until now natural historians have tried above all to marshal arguments to show the inevitability of the story of the dinosaurs, or at least of its major turning points and episodes. In this scenario the disappearance of the dinosaurs to make room for the long chain of mammals from which we emerged was a natural development.

In terms of Darwin's theory of the survival of the fittest, whereby rival organisms are pitted against each other in an environment containing limited resources, there was a conflict between the dinosaurs and the mammals. The latter won the day because, despite the terrifying power of their adversaries, the future was on their side. As warm-blooded creatures, mammals were more adaptable to changing climate, and since they were smaller, they were more agile and had a greater capacity for brain development. Thus the laws of evolution gradually tipped the balance in favour of the mammals and condemned the dinosaurs to extinction.

Current research into the extinction of species has demolished this theory. We now know that mammals probably had hardly anything to do with the disappearance of the dinosaurs, which may have been caused by a planet-wide crisis in the biosphere. The mammals inherited a biosphere brutally impoverished by a great catastrophe, due perhaps to the impact of an enormous asteroid, or fragment of a comet, that crashed into the earth. The history of evolution would have been quite different without this unforeseen event, which did not amplify existing trends but overturned everything that had gone before and created new rules.

An unforeseen disaster

Mammals did not appear after the dinosaurs but at the same time as them, at the beginning of the Mesozoic period (after another major crisis in the history of the biosphere). In fact mammals and dinosaurs lived together on earth for about 150 million years, and there is no indication that during this very long period there was any gradual extension of the ecobiological territory of the mammals into that of the giant reptiles. On the contrary, it was the mammals who lived what might be called a clandestine existence, preferably at night on the edge of areas occupied and coveted by the dinosaurs. In the vivid words of

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Contrary to what was once thought, "mammals probably had hardly anything to do with the disappearance of the dinosaurs."

the American palaeontologist Alfred S. Romer, they were "the rats of the Mesozoic".

Ten million years elapsed after the extinction of the dinosaurs before the mammals differentiated into forms as varied as bats and whales. By that time the emergence of the primates, which would eventually give rise to the human species, was not very far away.

Without this turn of catastrophic and unusual events some 65 million years ago, the rules of coexistence between mammals and dinosaurs might have continued indefinitely. Of course, a catastrophe of the same kind might have happened later, but there is no reason to say that it would have occurred in the millions of years that have gone by since. So it is easy to imagine other worlds just as plausible as ours, in which the continuing domination of the giant reptiles would have blocked the evolution of mammals, hindered the multiplication of species and certainly prevented the appearance of primates and hominids. This latter event is of major importance in natural history, but it is in no way a foregone conclusion programmed in the biological and structural characteristics of mammals and dinosaurs.

Yehuda Elkana contrasts two kinds of interpretation of history that he calls respectively the tragic and the epic. The tragic interpretation regards the unfolding of historical events as inevitable. This being so, the question that historians must answer is "How did what was due to happen actually happen?"[1] They must find the necessary and sufficient conditions that explain how the inevitable came about. In relation to the present, history must be rewritten by linking the facts, the stages and the stops and starts in a smooth linear progression which ends coherently and logically in the present moment. In this connection, the French philosopher Henri Bergson spoke of truth moving backwards.

The epic interpretation, on the other hand, is based on the principle that everything that has happened might have happened differently. In this view, the necessary conditions

are not as such sufficient, and the question asked by historians is: "Why did it happen in that way, given that the events could have taken an entirely different turn?"[2] With a scenario like this, "even the past evolves," as Aldo G. Garganti has rightly pointed out. The past, but even more the present and the future as they connect with the past.

Chance and necessity

These two scenarios for explaining the evolution of mammals are good illustrations of the contrast between a tragic scenario and an epic scenario. Many other important events and decisive changes that occurred in the history of the biosphere before and after the disappearance of the dinosaurs lend themselves just as well to this double explanation: from the extinction of certain species and the appearance of eucaryote cells (those of higher animal and plant organisms) from simpler and more "primitive" cells (bacteria), on up to those of *Homo sapiens*, endowed with an articulate language that even his most advanced hominid cousins probably did not possess.

'It is easy to imagine other worlds just as plausible as ours, in which the continuing domination of the giant reptiles would have blocked the evolution of mammals and prevented the appearance of primates and hominids.'

Is the present state of the biosphere the result of chance or necessity? Is its evolution the result of a complex project that follows a rigorously pre-established scenario which it is up to us to analyse and describe? Or is it the result of a chain of fortuitous events that can be described in detail but do not form part of the framework of logical reasoning that we have become used to through classical physics? If we could go back through the history of life step by step, revisiting all the critical stages of evolution, disregarding what has really come to pass, and going through all the decisive turning points again, would we always end up in worlds with more or less the same characteristics as our own, or in dissimilar, even radically different, worlds? That is the great and decisive question that specialists in evolution are asking themselves today.

When we consider a turning point in natural history that led to a certain result, we can certainly explain why the change took one form rather than another. But in most cases there are not sufficient reasons, at best the tip of an iceberg atop an invisible mass of facts whose contingent nature cannot be reduced to the laws of determinist logic and the calculation of probabilities, yet which play an essential role in the creation of the forms, structures and laws of our biosphere.

There have been two great revolutions in our intellectual tradition. The first was the exploration of space begun when, as a result of the work of Galileo, Copernicus and Newton, we turned away from the idea that the earth is at the centre of the universe. The second, associated with the work of Darwin,

The Time Traveller (1993), acrylic on canvas by the Brazilian painter Fernando Barata.

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"Ten million years elapsed after the extinction of the dinosaurs before mammals differentiated into forms as varied as bats and whales."

was the challenge to the anthropocentric view of the world. Only now are we beginning to see that these revolutions opened up two worlds to human thought, the first of which did not necessarily lead to the second.

The Copernican revolution and the advances of seventeenth-century science imposed a rigorous approach. The subject of scientific research had to be disencumbered of anything that might lead to a mistaken or ambiguous interpretation of the results. Isabelle Stengers has made a good analysis of the kind of rationality and logic associated with this process. It is the rationality of the experimenter, which leads to the creation of laboratory conditions that eliminate all parasitic elements so that the facts "can immediately and non-theoretically impose their own reading as long as no prejudice clouds the observer's mind."[3]

From this point of view the only facts worth the name are those obtained in perfectly controlled experimental conditions. The ability to repeat the experiment is an indispensable condition. Science can only be based on the repeatable, and, therefore, on generality.

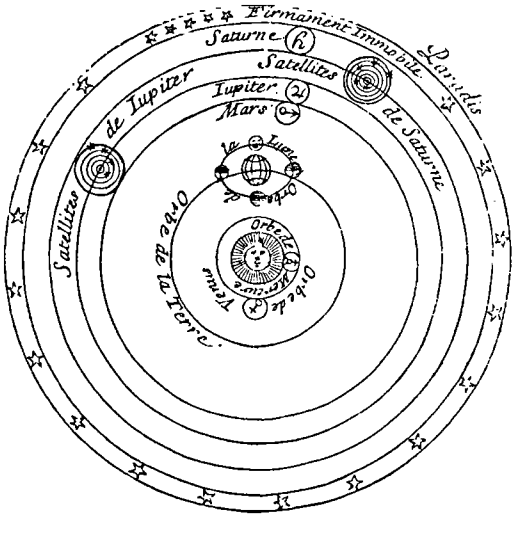
'The appearance of new life structures and dimensions is linked to a succession of unique and non-repeatable events.'

The Darwinian revolution and the questioning of our traditional conception of time are not just a follow-on of the "disanthropocentrism" of the universe begun by Copernicus, Galileo and Newton, any more than they are mere temporal extensions of the history of the universe. At a deeper level they constitute a revolution in our relationship to knowledge which necessitates a different approach to the idea of rationality. The naturalist sees that in world history the appearance of new life structures and dimensions is also linked to a succession of unique and non-repeatable events. For the naturalist, "facts are positive in the sense that they pose and impose problems. They cannot be accepted as such; they must be examined in the conditions in which they occur."[4]

In the rarefied atmosphere of the laboratory it is impossible to go back to the dawn of time and reconstitute the impact of the asteroid which doubtless led to the extinction of the dinosaurs. Naturalists must patiently decipher the chain of events that led to the present state of the biosphere and at the same time construct plausible alternative scenarios. By exploring these possible worlds, they can hope to reconstitute the complex tangle of the causes of our universe, the result of both chance and necessity. ■

1. *Antropologia della conoscenza*, Yehuda Elkana, Rome-Bari, 1989, p. 9.
2. ibid., p. 9.
3. *Le coeur et la raison*, L. Chertok, I. Stengers; Payot, Paris.
4. ibid.

In the 16th century, the Copernican system demonstrated that the earth is not the centre of the universe but revolves around the sun with the other planets.



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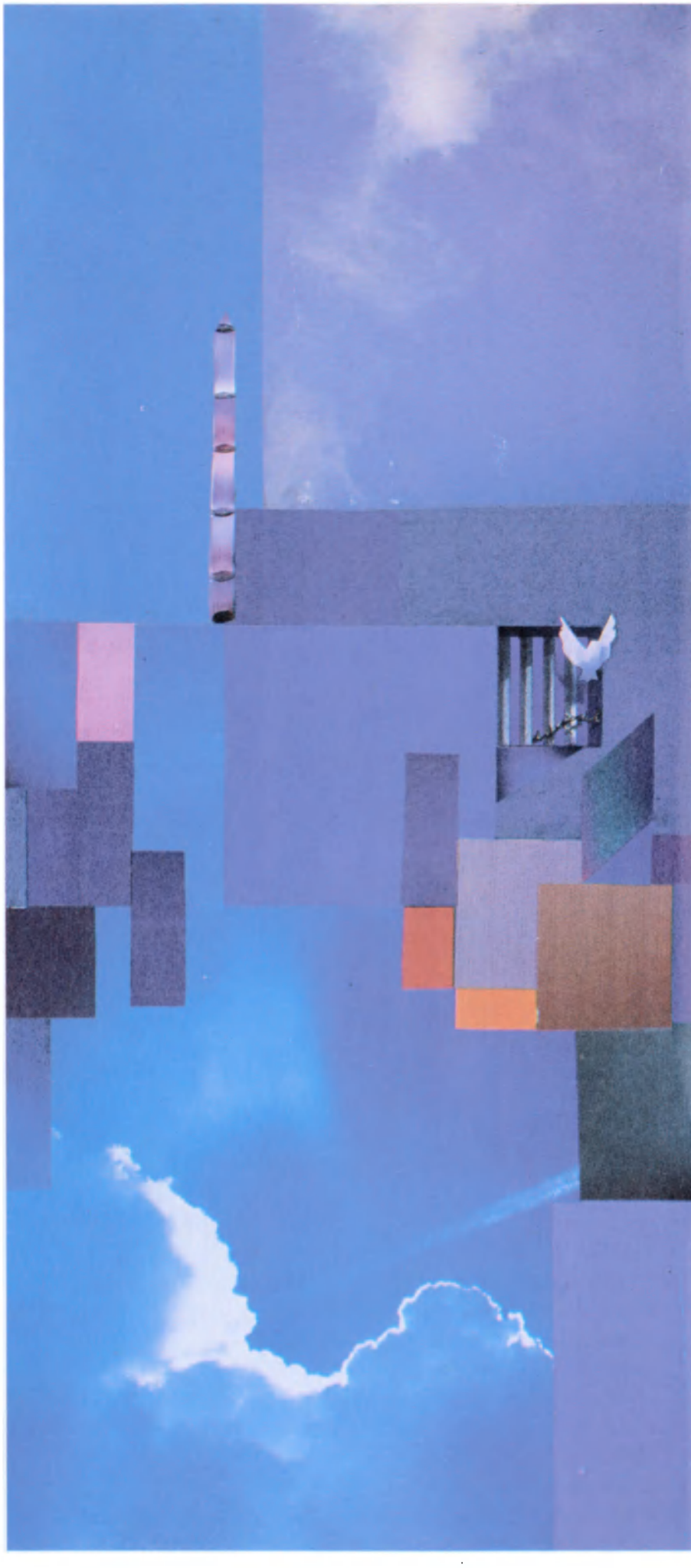

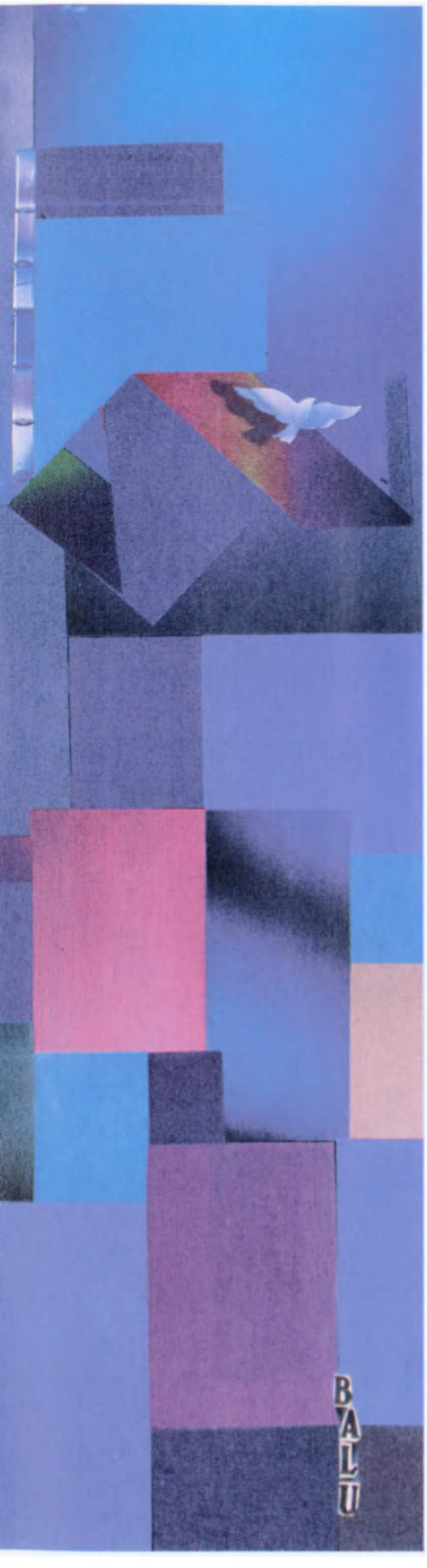

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Harmony, a collage on the theme of peace by the contemporary Indian artist V. Balu.

Logic, cultures and individuals

by Magoroh Maruyama

The second half of the twentieth century has been characterized by political, social and cultural movements toward heterogeneity and fragmentation. After the Second World War, many new independent nations won freedom from colonial subjugation. In the 1960s ethnic movements appeared in the U.S.A. More recently there have been subnational separation movements in Czechoslovakia, Yugoslavia and several other countries.

All these movements sought a national, ethnic or cultural identity which had been suppressed or threatened. These reactions were necessary and good, but they created their own unexpected trap: they tended to be separatist; and they tried to standardize and homogenize individuals within their group.

But newer trends have appeared. Massive migrations for political or economic reasons have increased, and professionals and experts cross national borders for other reasons. Most major countries now contain a large percentage of immigrants and resident foreigners. Heterogeneity has become interwoven and interactive within each society. Furthermore, foreign foods, dress and music have become accessible to those who do not travel to foreign countries. The individual's "ego identity" no longer consists in being one

thing, but in a unique pattern of combination consistent with his or her mind pattern.

Fallacious assumptions

Some assumptions of the social sciences today are becoming obsolete. Examples of these fallacious assumptions are:

1) each culture is perfect and it is better not to change it;

2) all "normal" individuals in a given culture are homogeneously acculturated;

3) babies are born with a blank mind, to be filled with culture;

4) a culture is a mentally healthy environment for all its normal members;

5) social change is traumatic to all persons;

6) cross-national migration increases anxiety;

7) contact with many cultures makes the individual lose his or her identity.

These fallacies stem from the belief that there is only one true logic.

However, heterogeneity is necessary and desirable in biological, ecological and social processes. This applies also to logical types. Some social scientists who have looked into the question have found that: there are many logical types which vary from individual to individual within each culture or social group; any logical type found in one culture can be found in other cultures, i.e., these logical types exist across cultures; cultural differences consist in the way in which some type becomes dominant and influences, transforms, suppresses, utilizes or exploits non-dominant types; it is possible for babies to be born with individually different logical types; individuals whose logical types are non-dominant cope with the dominant type in various ways: finding a niche to avoid the dominant mainstream; camouflaging their own type; consciously switching back and forth between their own type and the dominant type;

Below, *Dancing Maenads*, a fresco by the Italian painter Giulio Romano (1499-1546) in the Palazzo del Te in Mantua. Opposite page, Chinese polychrome terra-cotta statuettes of dancers (Tang dynasty, 7th-10th centuries).

© Ainan-Giraudon, Paris

repressing their own type into the unconscious and reactivating it under favourable circumstances; repressing it irreversibly; becoming a rebel or reformer; emigrating.

Even though there can be as many logical types as there are individuals, the following four types and their combinations account for about two-thirds of the individuals in most countries.

H-type	I-type	S-type	G-type
homogenist	heterogenist	heterogenist	heterogenist
hierarchical	isolationist	interactive	interactive
classifying	randomizing	stabilizing	change-generating
opposition	independence	absorption	exploration
one truth	subjective	poly-objective	poly-objective
competitive	uniquing	co-operative	cogenerative

'The individual's "ego-identity" no longer consists in being one thing but in a unique pattern of combination consistent with his or her mind pattern.'

© Bonora-Giraudon, Paris

H-type individuals try to standardize everything, seek universal principles, rank-order things, put things in neat categories, look for opposites, place things between two opposite poles, believe in one truth, compete with others, and think that one's gain is someone else's loss, and therefore in order to win one must make someone else lose.

I-type individuals rebel against homogeneity, look for freedom from interference, seek self-sufficiency, caprice, uniqueness and subjectivity, and believe that if many people work together their efficiency decreases. Pollution is a result of many people living together, and if everyone went to the mountain and grew his or her potatoes, there would be no problem.

For S-type individuals, things cause one another in cause-effect loops, that is to say, the effect comes back to the cause directly or indirectly through other elements. Individual differences make co-operation possible, while sameness breeds competition and war. Heterogeneous elements interact to maintain a pattern, and interaction is mutually beneficial. In binocular vision, the differences between two images enable the brain to compute depth. Likewise, different points of view among many people are useful in computing invisible dimensions.

G-type individuals are similar to S-type individuals, except for their belief that interaction generates new patterns.

People in different logical types do not

necessarily disagree. They may agree, but their point of agreement may be based on different assumptions, and therefore they may face problems later. For example, several people may agree that decentralization is good. H-type persons may agree because the whole country is seen as homogeneous or standardized, and nothing is lost by dividing it. I-type persons may agree because they see each part of the country as independent, and it makes sense to decentralize. S-type and G-type persons may agree because they see heterogeneity, but with the assumption that different parts would naturally interact for mutual benefit.

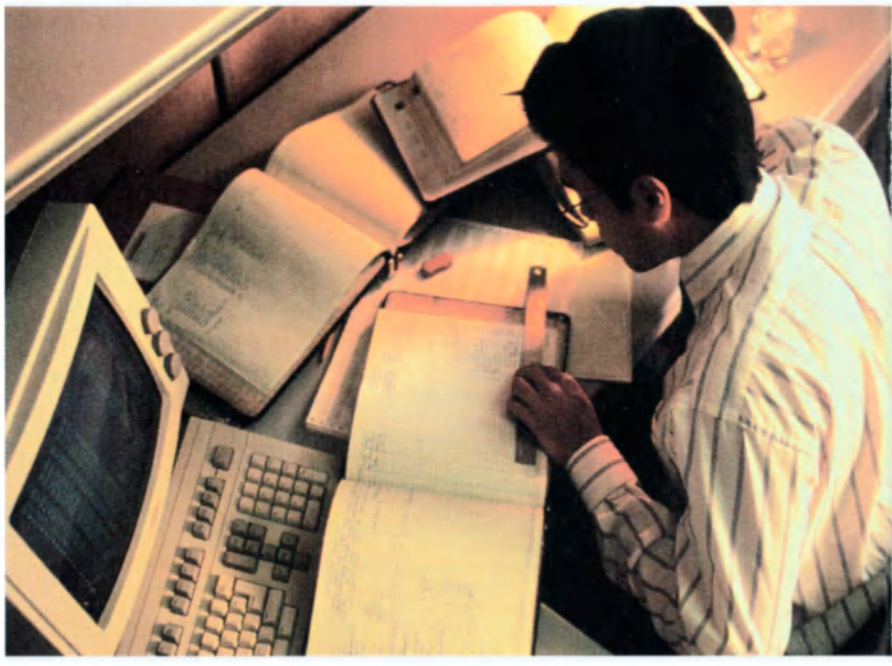
Thus agreement does not necessarily mean that the same logic is used. One must be aware of different logical types in order to avoid later problems. Illusory agreement is dangerous because later disagreement makes one think that the other person was insincere or lying. Consequently it is important to be aware of the differences in logical types.

Unawareness of differences in logical types may make people doubt one another's personal integrity. For H-type persons, personal integrity consists in adhering to absolute principles regardless of situations. I-type persons stick to their own principles regardless of what other people say. The way in which persons of S-type and G-type logics act depends on the situation. Persons of different logical types may thus consider one another to be unethical.

Cultures and logical types

In each culture, a certain logical type becomes dominant and influences, transforms, suppresses, utilizes or exploits non-dominant types. But all logical types exist in each culture, even though some of them may be hidden, camouflaged or repressed. For example, during the period when Germany and France were dominated by H-type Gothic architecture or Baroque music, individuals with S-type or G-type logics found their niche and outlet in painting.

When we compare cultures, we do so in terms of the dominant type. For example, H-type dominates in Sweden, while a mixture of



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An accountant at work.

S-type and I-type is dominant in Denmark. In Asia, Koreans show strong H-type characteristics, while Indonesia is strongly of S-type. In Japan, SH type is dominant, while in the United States, HI type is dominant. In this sense, Danes are closer to Indonesians than to Swedes, and Koreans are closer to Germans than to Indonesians. The popular notion of East/West contrast does not hold.

Each profession has a dominant type regardless of countries. Accountants tend to be of H-type, and painters tend to be of I, S or G-type.

Which logical type is more scientific?

Newtonian astronomy was of H-type. Nineteenth-century thermodynamics, based on independent movements of molecules, was of I-type; early cybernetics in the 1940s was based on the S-type; the cybernetics of the 1960s on a combination of types G and S.

Archaeological research in Japan has showed that the Jômon culture, which began 11,000 years ago, had G-type characteristics, and that the S-type was dominant in the Yayoi culture which arose 2,300 years ago. The H-type Yamato culture reached Japan via Korea 1,500 years ago, and this logic eventually became the official dominant logic of the ruling class, even though farmers still use S-type logic and the merchant class which

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emerged during the seventeenth century practised G-type logic.

In pre-colonial African cultures, G-type logics were practised. Oral traditions explicitly stated that heterogeneity made co-operation possible while homogeneity bred wars.

Communication

It is extremely difficult, if not impossible, for persons who think using I, S or G-type logics to communicate with those who use H-type logic, because the H-type believes in its "universal truth" and tries to reduce everything into the limited dimensions of its thought structure. As long as the result of the dimension reduction is internally consistent, the H-type person is convinced that it is the correct interpretation even though it may miss the point completely.

The dominance of the H-type logic in many societies hampers a heterogenistic view of cultures. This fact has many implications:

☛ many policies of standardization are based on the incorrect assumption that sameness is necessary for peace and differences are the cause of conflicts. Policies should be formulated to encourage heterogeneity and mutually beneficial interaction between individuals;

☛ the suppression or non-utilization of non-dominant logical types is a waste of precious human resources;

☛ current educational and vocational systems are based on H-type logics. Individuals of other logical types are disadvantaged or excluded. This is a violation of equal opportunity in education and in employment;

☛ it is currently fashionable to compare cultures as if each culture is homogeneous. However, non-dominant logical types exist under the surface. The key to successful multicultural management is to discover individuals of non-dominant types.

☛ until now, cross-national population movements were interpreted in terms of labour demand and supply, or professional skill matching. However, many people migrate for the purpose of logical type matching. We can expect increased migration for this reason.

☛ many people are unaware that their own logical types are non-dominant and therefore they are disadvantaged in education and employment. More importantly, they may feel uncomfortable, unhappy or frustrated without being aware of the reason. It is important for them to become aware of their own logical types. ■

'The suppression or non-utilization of non-dominant logical types is a waste of precious human resources.'

© IPS, Paris

The American painter Jackson Pollock (1912-1956) demonstrates his "drip technique"—controlled dribbling and spattering of paint on canvas.

Unesco/Gil Jacques, Montréal

'THE VOICE OF THOSE WHO NEVER SPOKE'

The suffering of the indigenous communities that were subjugated and deprived of their most elementary rights—the right to cultural identity, to the land of their ancestors, to their language, freedom and beliefs—is one of the disasters of recent centuries that must be etched in the collective consciousness alongside slavery and other affronts to humanity. It happened slowly and silently and it has lasted to the present day in the form of social prejudice and economic structures, of education systems and political power machines that perpetuate discrimination and neglect.

The Indigenous Initiative for Peace inspired and guided by Nobel Peace prize-winner Rigoberta Menchú is a sign of how far the situation of indigenous people has changed in recent years.

The concept of "initiative" implies that these peoples have decided to make a dynamic response to the many problems, old and new, that beset them; that they have the will to identify, study and seek solutions to them that are consonant with the times; that they are prepared to undertake this task without falling back on imported models that distort their cultural heritage and without repeating the mistakes of the past; that they are resolved to shape their own destiny.

This attitude is in itself a revolution, one of dialogue and indocility after the centuries of silence and submission that these communities have suffered. It is a creative and peaceful revolution, which presupposes a huge effort to achieve educational renewal and social transformation, access to full citizenship and participation in decisions great and small, and which will henceforth make a difference to their shared lives. Rigoberta Menchú has summed up that hope in these lines:

A long darkness obscured my face;
long are my dreams, immense my hopes.
But the dawn will come, brightness will come.
To the utmost height of the azure vault shall soar
the voice of those who never spoke.

Joining the two hemispheres

In many countries, particularly those of Latin America, the lot of the indigenous peoples is a lingering blight on the progress of democracy. On the one hand, there is the continuing problem of their incorporation into the life of the nation, under conditions of full and effective citizenship. On the other, these peoples, after falling prey to historical iniquities (such as those that occurred in America in the sixteenth century) went on to suffer at first hand from political strife and civil or international wars whose effects were added to those of exclusion and marginalization.

So it is important to highlight the peace-seeking ingredient of this Initiative because without peace the political, social and economic

goals that these communities have set themselves cannot be realized.

The construction of peace involves more than efforts to prevent the outbreak of armed conflict. It means removing the causes of individual and collective violence that spark off wars in the first place. Such violence may take many forms: at the political level it emerges as oppression and tyranny; in economic life, as exploitation and poverty; in the social sphere, as exclusion and intolerance. Any effort to establish a culture of peace must be targeted at the roots of violence and make a priority of communicating values, forging attitudes and devising institutions that will extirpate violence from human minds.

Industrial civilization and indigenous cultures must engage in a dialogue that cannot fail to be of mutual benefit to them. The former is the repository of a great deal of knowledge, particularly technical know-how, but is short on wisdom; it has lost a sense of human fulfilment. Peoples living in precarious conditions of material development still possess this wisdom and contact with nature, but they lack the technological expertise that abounds in the industrialized countries. To join these two hemispheres of humanity is tantamount to curing humanity of its hemiplegia. Still, these material comforts and facilities do not suffice to make us respect the natural environment and do away with the most glaring injustices of our society.

In the *Pópol Vuh,* the sacred book of the Mayas, there are some verses laden with symbolism that tell how the first human beings were annihilated as retribution because "they did not think, did not speak with their Creator". Those men and women, made of wood, had abused their immediate surroundings and upset the natural balance that united them with the cosmos. As a punishment, the gods allowed the earth, the animals and even household objects to rebel against them and destroy them.

The revenge exacted by animals and even by objects on the human beings who dominate them—a feature that exists in one form or another in almost all cosmogonies—is an allegory of the woes that human beings may bring on themselves through the misuse of power, especially the Promethean might of the intellect. A noted leader of the North American Indians, Chief Seattle, put it like this in 1855:

"The earth does not belong to man, but man belongs to the earth. Man has not woven the fabric of life; he is but a strand of it. Everything he does to the fabric he will do to himself. What befalls the earth will befall the children of the earth."

A wealth of difference

We thought we had magic formulae to suit all situations. As if all countries were uniform, and as if their histories, their natural resources, their traditions, their beliefs, their forms and styles of living were of no account. As if it were possible to ignore the infinite diversity of individual lives, of the social, economic and cultural contexts in which people grow up, of the ideas imparted to them, of their thoughts and impressions, their states of mind, and so on. We have forgotten the cultural dimension of personal and collective development. Instead of believing that wealth lay in diversity, we imagined that it was uniformity which, at least in economic terms, ought to prevail, forgetting that difference is wealth—as long as it unites us.

Knowledge of and respect for difference, full receptiveness to others. May the diversity of cultures long continue, of those "hybrid and wandering cultures", which, as Carlos Fuentes put it, are our greatest—our ultimate—source of wealth. ■

Kirchgessner/Schuste © Explorer, Paris

OLINDA *the sleeping beauty of northeastern Brazil*

by Joel Franz Rosell

Above, Olinda, with the city of Recife in the distance.

Opposite page, traditional handicraft shops line the Mercado da Ribeira, the former slave market.

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of Cuba, is a journalist with the French radio station Radio France Internationale. He also teaches Spanish-American literature at the University of Marne-la-Vallée, near Paris, and is the author of many children's stories.

The city of Olinda in north-eastern Brazil once wore its heart on its sleeve. It owes its name to the exclamation uttered by its Portuguese founder when he saw its site for the first time: "*Oh linda* situação para se fundar huma villa!" ("Oh what a beautiful place for a city!"). Today it does not reveal its charms so quickly. Visitors who set out from Recife, the capital of Pernambuco state, and drive through seven kilometres of built-up area, will not see on the skyline the eight uninhabited hills sweeping down to the sea which so enchanted the sixteenth-century Portuguese colonizers of Brazil.

Only when they discover Olinda's "high town" will they be able to appreciate this haven of peace on the doorstep of bustling Recife. Then they will savour the dialogue of palm trees, roofs and belfries, the admirable contrast between old walls and luxuriant nature, between a glorious sun and the pure blue sea. Only then will they exclaim, like the Portuguese explorer of old: "Oh, what a beautiful place. . . ."

SWEET AND SOUR

Olinda was founded in 1537. It soon became a magnet for the rich slave-

Some of South America's finest colonial architecture has survived in a city that was once the capital of Brazil's sugar trade

owners of the plantations, who built on the hillsides magnificent houses where they could take refuge from the stifling, insalubrious heat of the inland plains. Churches and monasteries were built, and the commercial infrastructures required by the flourishing sugar and slave trade began to be developed.

In 1612, when Brazil was the world's leading sugar exporter, there were a hundred-odd sugar refineries in Olinda—twice as many as there were in Salvador, the capital. But the prosperity of the northeast kindled envious appetites, and the Dutch captured the future province *(capitania)* of Pernambuco. It was during the brief period of Dutch occupation (1630-1654) that the fate of Olinda was sealed.

First of all, the new arrivals set out to modernize Olinda and turn it into a port that could compete with Recife. When the population rebelled they were forced to abandon their plans. In reprisal they put Olinda to fire and the sword in 1631. A large number of sixteenth-century houses, churches and monastic buildings, the fine flower of colonial architecture, disappeared in the flames.

The return of the Portuguese in 1654 coincided with the expansion of Recife as a trading centre and a city, and encouraged the rich land-owners of Olinda to rebuild their city. They vied with each other in building luxurious houses, giving rise to a saying which became proverbial: "People live better in Olinda than at the king's court." But rivalry between the merchants of Recife and the Olinda sugar magnates led in 1710-1711 to a civil war which was won by Recife.

This political blow took place at a time when most of Olinda's architectural heritage had already been built. Fortunately, the city's economic decline was slow enough to enable the magnates

C. Valentin © Hoa Qui, Paris

C. Valentin © Hoa Qui, Paris

to complete the buildings they had begun.

Although Olinda lost temporal power, it became an important religious centre. Between 1678 and 1823 it was the seat of an archbishopric whose seminary, monasteries and schools became the mainspring of religious activity in northern Brazil. Two important events (the modernization of religious education begun by Bishop Azeredo Coutinho in the late eighteenth century and the creation of a law faculty a few years later) had such a great impact that Olinda became known, with a certain amount of exaggeration, as the "Brazilian Coimbra".

GONE WITH THE WIND

The visitor to Olinda who looks in the city's churches and monasteries for treasures accumulated over the centuries will look in vain. A handful of vestiges of these treasures can be seen in the city's museums, but most of them have mysteriously disappeared, possibly recovered by their owners (to compensate for the lack of banks, rich families entrusted their precious objects to the protection of the churches).

The history of Olinda was also punctuated by a series of crises which opened the door to the systematic pillage of precious jewellery, paintings, furniture, books and even ceramic tiles (*azulejos*). Between the expulsion of the Jesuits in 1760 and the collapse into ruins of the Carmelite monastery in this century as a result of neglect, examples of vandalism were legion. One prior removed a statue of Our Lady of Mercy from its pedestal and sold it to make money for himself.

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Above, a house with a façade of enamelled tiles (*azulejos*).

Opposite page above, the cathedral, the oldest church in Olinda, was built around 1540.

Opposite page below, the Monastery of São Bento (St. Benedict), entirely rebuilt in the 18th century.

All the same, Olinda has suffered less from the infidelity of its elites, the negligence of its clergy, piracy and the hand of time than it has from slapdash restoration work carried out at the beginning of this century, including "improvements" made to the cathedral in 1911 and the demolition of vestiges of the Carmelite monastery by order of the prefect in 1907.

A NEW AGE OF PROSPERITY

Fortunately, it was not yet too late when the Brazilian government stepped in and took the first steps to save Olinda's heritage in 1937. The implementation of a battery of judicious protection and restoration measures in 1962, 1973, 1975 and 1980 was crowned on 21 March 1983, when the site and city of Olinda were included on UNESCO's World Heritage List. This marked the start of a new age of prosperity for northeastern Brazil's sleeping beauty.

There is much to admire in Olinda

OLINDA

LOCATION:

Olinda occupies a hilly coastal site, 7 kilometres from Recife, capital of Pernambuco State in northeastern Brazil.

DESCRIPTION:

The city's 17th- and 18th-century layout has survived almost intact, and many civil and religious buildings are, by virtue of their architecture and rich decoration (wood carvings, *azulejos*, silver work), remarkable examples of Portuguese baroque art. A short distance from the factories and skyscrapers of Recife, Olinda still has the charm and enchantment of a city of the colonial period.

LANDMARKS:

1537: Olinda is founded by Duarte Coelho Pereira.
1631: The town is sacked by the Dutch.
1654: The Portuguese return and a long period of reconstruction begins.
1678-1823: Olinda is the seat of an archbishopric.
1800: A seminary is founded.
1811: A botanical garden is planted.
1828: The Academy of Legal Sciences is founded.
1980: Olinda is declared a national monument.
1983: Olinda's historic centre is included on UNESCO's World Heritage List.

MAIN BUILDINGS:

Cathedral
Church of the Mother of Divine Grace
Carmelite convent and church
St. Benedict's monastery and church
Monastery of St. Francis and the church of St. Mary of the Snows
Church of the Misericord
Church of St. John the Baptist
Church and monastery of Our Lady of the Immaculate Conception
Archbishop's palace
Pernambuco Museum of Contemporary Art (the former prison)
Many houses and other buildings decorated with *azulejos*
Ribeira Market

© Carlos Freire, Paris

today: the imposing façade of the Carmelite church, the rustic grace of the houses with their pastel-coloured walls and Moorish balconies, the restrained baroque of the monasteries of St. Benedict and St. Francis, with their magnificent interiors, their precious wood furnishings, their frescoes and their *azulejos* decorated with designs that unexpectedly blend sacred and profane themes. No visit to the city is complete without a stroll through the Ribeira market, where wood and clay statues and paintings depict men who were once sold there as slaves. And Olinda would not be Olinda without its tropical vegetation, its eternal garden of trees—palm and coconut, mango and spondias, cinnamon and bread-fruit, flame trees and banana trees.

Sometimes too the sleeping beauty awakens and emerges from her tropical torpor. There are explosions of joy at carnival time, feast days and Christmas; processions in honour of St. Antony, St. Francis and the Sacred Heart take place with time-honoured splendour, memorable for African drumbeat and spangled costumes.

In Brazil there is a tendency to contrast Olinda and Ouro Preto, two jewels of "classical" architecture that feature on the World Heritage List. Ouro Preto, the capital of the "gold cycle" in the eighteenth century, is isolated in the mountains of the hinterland. It is an austere and imposing jewel, which seems to have been hewn from an inhospitable mountain-top. By way of contrast, Olinda, capital of the "sugar cycle" is the flower of the northeast, whose corolla, as if modelled in clay soaked in the juice of sugar-cane, straggles over sunny hillsides rocked by the rhythm of the sea.

If Olinda needed a patron saint, the "Virgin of the Siesta" would be a good choice. Not so much because of the sleepiness encouraged by its peaceful streets barely disturbed even by birdsong, its quiet gardens and the shadows cast by its buildings, but because the long sleep that for a century preserved it from the sound and the fury of the world also preserved it from the property speculation and rampant urban growth that have turned neighbouring Recife and many old colonial towns into soulless modern cities oblivious of their past.

Several suitors have tried to awaken the sleeping beauty: students at the beginning of the last century, holiday-makers attracted by its deserted beaches, geologists who dreamed of turning it into a phosphate centre. They all failed because they did not understand that only a kiss of love for its past could work this miracle.

If Olinda lives from its heritage today, it is not a dead or immobile city. Craftsmanship, culture and tourism are the main sources of income for its youthful population of over 200,000. Olinda could take as its motto an anonymous graffiti drawn on an old wall on Carmel Square: "Saudade do futuro", nostalgia for the future. ■

Above, Matriz church.

Right, traditional folk dancing in an Olinda street.

© Carlos Freire, Paris

View of southeast Mauritius, with the town of Mahébourg in the distance.

C. Pavard © Hoa Qui, Paris

MAURITIUS

Paradise lost or Paradise regained?

by France Bequette

Mauritius emerged from the Indian Ocean some eight million years ago, and since then many animal and plant species—some of them unique—developed there in extreme geographical isolation.

The island lies some 800 kilometres southeast of Madagascar, and, with Rodrigues, the Seychelles and Reunion, belongs to the Mascarene group of islands. Inland from a fringe of sandy beaches, peaceful lagoon and coral reefs, is rugged and mountainous terrain. On this volcanic island of idyllic greenery and flowers, people of a variety of origins and religions live on good terms. The climate is temperate, although between December and April there may be occasional violent cyclones.

Meteoric economic growth based on sugar cane, tea and tourism has brought full employment to Mauritius and turned it into what its people like to call the "tiger of the Indian Ocean". Although the government has been concerned about the environment since the 1970s, it took a demonstration of international solidarity by conservationists before part of the island's animal and plant heritage could be saved. Today it is fair to say that Mauritius has become a veritable laboratory for the restoration of endangered species.

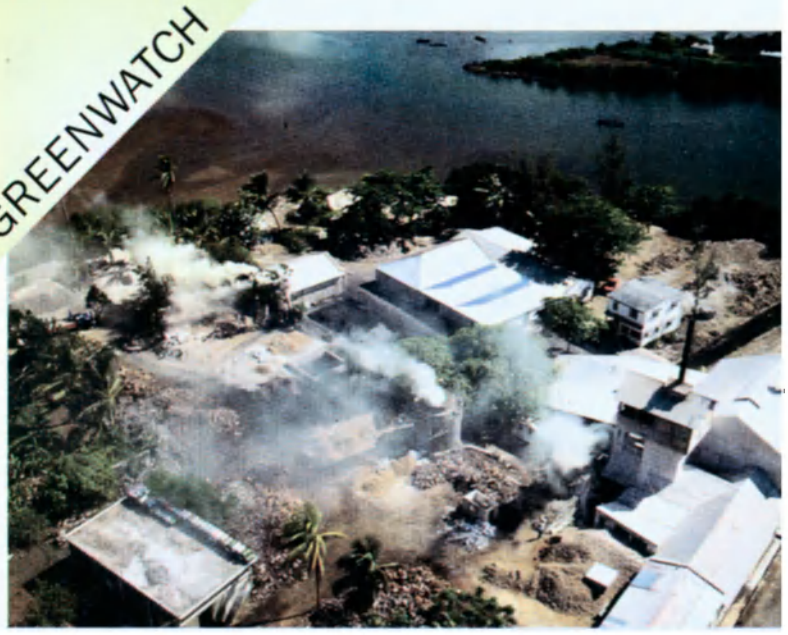
PREDATORS AND HEALERS

When people arrived in Mauritius in the 16th century the stage was set for an ecological disaster. The dodo (*Raphus cucullatus*) and the solitaire (*Pezophaps solitaria*), two big flightless birds, were soon exterminated, and subsequent changes in habitats, deforestation for arable land, reforestation with non-endemic trees and the introduction of certain animals from outside led to the disappearance of several species of birds, of giant lizards, snakes, tortoises and countless insects and plants.

Until Mauritius became independent in 1968 it was visited or ruled in turn by the Portuguese, the Dutch, the French and the British, each of whom introduced animals which in some cases became pests and preyed on endemic species. Examples include the Timor deer (*Cervus timorensis*) and the wild boar (*Sus scrofa*), which damage the forest and hence the island's birdlife—the deer eat the indigenous plantlife, and the boars uproot young plants. Monkeys (*Macaca fascicularis*) and brown rats (*Rattus norvegicus*) raid nests and eat birds' eggs and nestlings, mongooses (*Herpestes auropunctatus*) and feral cats (*Felis cattus*) eat birds at all stages of development.

The Mauritius kestrel (*Falco punctatus*), the island's only endemic bird of prey, has been almost wiped out, partly because its recently fledged young are easy prey since they spend much time on the ground in the first few days after leaving the nest, and partly because the birds have been victims of the pesticides which are widely used on the island. Only two pairs were known to survive in the 1970s and attempts were made to get them to breed in captivity. Between 1984 and 1991 235 young kestrels were released in the wild, and the goal of around a hundred nesting pairs should now be within reach. The pink pigeon (*Columba mayeri*) was also threatened with extinction. Pigeons sent to the Island of

FRANCE BEQUETTE is a Franco-American journalist specializing in environmental questions.



C. Vaisse © Hoa Qui, Paris

Lime kilns in Mahébourg.

Jersey and monitored by specialists with support from the Jersey Wildlife Preservation Trust (founded by the British naturalist Gerald Durrell) reproduced and were reintroduced in Mauritius. A site for raising threatened birds has since been established in Black River Gorges National Park. The large echo parakeet (*Psittacula eques echo*) has also been saved in the nick of time. Only a dozen of these birds were left in 1986.

BLACK RIVER GORGES NATIONAL PARK

The creation of Black River Gorges National Park was an important step in nature conservation. Proposed by the World Conservation Union (IUCN) in 1973, the project finally came to fruition in 1994. The Park covers 6,574 hectares in the southwest of Mauritius, where the land rises to an altitude of 817 metres. Here too endemic plantlife is being stifled by exotic plants such as the Chinese guava (*Psidium cattleianum*), a bush imported from Brazil that monopolizes space and light in the undergrowth, privet (*Ligustrum robustum*) from Sri Lanka, the Madagascar traveller's-tree (*Ravenala madagascariensis*) and "Framboise marron" (*Rubus alceifolius*) a thorny bramble that forms dense thickets and clambers up host trees, often several metres high.

In a carefully fenced-off corner of the park workers have pulled out all the exotic plants by hand. This is a frustrating job because the weeds will grow back if only a small fragment of the plant is left in the ground. This was an urgent job, however, for 80 per cent of the island's 900 plants, 300 of which are endemic to Mauritius, are threatened, and only about a dozen specimens survive of 51 of them.

The Ministry of Agriculture has received financial aid from the World Bank and technical assistance from the Mauritian Wildlife Appeal Fund (MWAF), a non-governmental organization that in 1986 took in hand the islet of Ile-Aux-Aigrettes, which lies offshore from the town of Mahébourg. IUCN botanist Wendy Strahm drew up a plan to eliminate all animal and plant intruders, while endemic plants were grown in nurseries. The extraordinary "Café Marron" (*Ramosmania heterophylla*), a single specimen of which survived, was propagated from cuttings at the Royal Botanic Gardens at Kew in the United Kingdom.

THE DARK SIDE OF PARADISE

Despite these spectacular successes, Mauritius has not avoided the problems caused by rapid development and a big increase in tourism. The island's 426 industries consume large quantities of water (up to 5,000 m^3 per day) and discharge effluent—often untreated—into the rivers. Some 60,000 tonnes of fertilizer a season, or 600 kilos per hectare, are used in sugar cane production, which occupies about 90 per cent of the arable land. More than 1,000 tonnes of pesticides are sold each year to farmers, and according to a report on the "State of the Environment in Mauritius" prepared for the Rio Earth Summit, these products threaten the quality of drinking water and the lagoon. Measures taken by the government include renovating and extending the sewer system (which in 1994 collected only 18 per cent of all effluent) and building treatment plants and outfalls into the sea.

More than 300,000 tourists swell the million-strong population of Mauritius every year. In 1990 tourism represented 3.1 per cent of GDP. It has been estimated that the island's maximum potential for tourist reception is about one tourist per three inhabitants. The figure of 400,000 tourists projected for the year 2000 will require a 15 to 40 per cent growth in the island's hotel capacity. This is an incentive for promoters attracted by the temptation of easy money to cover the northern and western coasts with concrete, without waiting for the results of "Environmental Impact Assessments" carried out by the authorities. Each year a million tonnes of sand are scooped from the lagoon. At Pomponette, for example, the coast has retreated by five metres in the last five years. The authorities have restricted sand mining to specific sites, and a project to restore the beach is underway.

Although 800 tonnes of solid

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Alice and the dodo, an illustration from *Alice's Adventures in Wonderland* (1865) by Lewis Carroll. A flightless bird native to Mauritius, the dodo was hunted for its flesh and became extinct around 1560.

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A pink pigeon (*Columba mayeri*), a bird native to Mauritius.

household and industrial wastes are collected every day, they are disposed of in open dumps, and plastic bags and bottles litter the countryside and the shore. Another problem is that of waste borne to the coast by winds and currents. In 1992 there were only two recycling plants for glass, paper and cardboard. In the last few years eight official dumps have been or are being rehabilitated, and the construction of two sanitary landfill sites is planned.

In Mauritius, as elsewhere, protection of the environment means that everyone must give a hand. Some forty environmental organizations registered with and supported by the Ministry of the Environment are working hard to inform and educate the population, particularly children. There are many environmental clubs, sponsored by a wide range of bodies including village councils, and young people's and women's associations. Hopefully, the younger generation will remember that they live in a corner of paradise and will do what their elders have left undone.

FOR FURTHER INFORMATION

contact the Department of the Environment, Ministry of the Environment and Quality of Life, Ken Lee Tower, Line Barracks Street, Port Louis, Mauritius.
Tel.: (230) 212 60 80;
fax: (230) 212 66 71.

YOUTHFUL HANDS TURN WASTE TO GOOD USE

UNESCO'S Division of Youth and Sports Activities recently commissioned a survey of 120 youth and student organizations around the world to find out if they were participating in waste recycling activities. Twenty responses were received from Europe, 17 from Africa, 7 from Asia, 6 from Australasia and the Pacific and 6 from North and South America. They described a raft of original projects and should provide ideas for anyone interested in working for the environment.

The Packwach Tools Production Centre in Uganda has formed several groups of unemployed young men and women. The women collect material and twine to make carrier bags and fishing nets, while the men collect steel scrap and learn blacksmithing skills. The experience and training can help the young people obtain professional credentials in construction, metalwork and joinery.

A little further to the south, in the Republic of Tanzania, many youth groups have also organized metal-working shops. The Tanzanian Railways and abandoned sisal plantation factories are important suppliers of scrap metal. A British organization, Tools for Self Reliance U.K., is helping the young metalworkers by providing refurbished second-hand equipment. From 1990 to 1993, 25 blacksmith units produced some 300,000 tools and implements.

The Gecco Environmental Centre in Namibia has both educational and cultural aims. Working with local schools, the Centre gathers scrap and litter of all kinds and makes large sculptures of animals such as rhinos. The sculptures have a metal rod structure wired together with mesh stuffed with non-perishable materials and decorated with sea shells and coloured glass. The children learn to avoid waste and enjoy the creative art work.

In Papua New Guinea members of the "Iumi Tugetha" (You and me together) Youth Group collect and export non-ferrous scrap metal. With the proceeds from their first shipment they bought a mini-aluminium crusher-bailer from Australia to process aluminium drinks cans, and now they would like to acquire a furnace to smelt the aluminium and make castings. Group members receive a small allowance, which strengthens motivation.

On the Japanese island of Shikoku the attitude to recycling is more philosophical but no less realistic. Taiyo To Midori No Kai (The Sun and Green Association) works with mentally handicapped people on the principle that "in order to save the future of mankind, we must drastically change our attitude to life. To know how to be contented and to give thanks for what we have—that's why we chose recycling goods as our project".

FOR FURTHER INFORMATION

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Fax: (33-1) 45 67 14 99

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WHEAT PIPS RICE

The Consultative Group on International Agricultural Research (CGIAR) reports that wheat is on the way to becoming the number one food crop in developing countries, surpassing rice. Formerly confined to the temperate and subtropical zones, wheat can now be grown as a winter crop in warmer climates. Asia harvested 217 million tonnes in 1994, or eight million tonnes more than Canada, the U.S.A., Europe and Mexico combined (209 million tonnes). A grain whose advantages include resistance to disease and pests, low cost, rapid growth, genetic diversity and flexibility, wheat is making a major contribution to increased food security.

COUNTDOWN FOR THE INDOCHINA TIGER

The World Wide Fund for Nature (WWF) reports that the Tiger of Indochina is the most threatened of the five remaining sub-species of tiger. One animal is being killed each week by poachers, and if the current rate of destruction continues the Tiger of Indochina will be extinct in ten years' time.

FRANCE SETS ITS SITES FOR EUROPE

By its "Habitats" directive of 21 May 1992 the European Union is seeking to preserve biodiversity in Europe by establishing a network of sites containing natural habitats and plant and animal species of interest to member countries. In France 1,700 sites have been identified, covering a surface area of 7 million hectares. After evaluation by the National Museum of Natural History, a group of the sites will be selected and submitted to the European Commission for inclusion in the network, known as "Natura 2000".

ENVIRONMENTAL EDUCATION FOR THE 21ST CENTURY

In November 1995 the Organization for Economic Co-operation and Development (OECD) published a report on "Environmental learning for the 21st century" which describes how a network of educators, researchers and policy-makers in OECD countries have co-operated in local initiatives to resolve environmental problems and develop attitudes and skills to manage future developments. It cites three main challenges that lie ahead: making environmental education a mainstream activity, providing teachers with the skills and competence to teach and develop environmental education, and finding a place for environmental education in the core curriculum.

"Environmental Learning for the 21st Century", OECD, Paris, 1995. 115 French francs, ISBN 92-64-24478-6. By post: VPC OECD, 2, rue André-Pascal, 75775 Paris Cedex 16. Tel.: (33-1) 45 24 82 00; fax: (33-1) 49 10 42 76.

SCIENCE DISCOVERS THE SAOLA

The Vu Quang ox (*Pseudoryx nghetinhensis*), an animal previously unknown to science, was discovered in the Vu Quang (Viet Nam) Nature Reserve in June 1994. Local people had long known of the animal, which they call the Saola, and kept its horns as trophies. While gathering data on the Saola a few months earlier, a research team sponsored by WWF, IUCN and Viet Nam's Forest Ministry came across another undescribed animal, the giant muntjac (*Megamantiacus vuquangensis*), a large ruminant. Since these discoveries, the Vietnamese government has enlarged the Vu Quang reserve from 16,000 to 60,000 hectares and imposed logging and hunting bans.

PLANTS THAT CLEAN TAINTED SOIL

The salts of selenium, a metalloid present in certain kinds of soil, can pose a threat to aquatic wildlife if they infiltrate into water courses. When California (U.S.A.) horticulturist Delbert Herschback noticed that his irrigation water was leaching this toxic substance from the soil he came up with the idea of growing plants such as mustard, which absorb the salts into their tissue. Other plant species consume metals such as mercury, zinc, lead, copper and cobalt. Euphorbiaceae, which absorb nickel, and other metal-scavenging plants are currently being studied by researchers in the U.S.A. and the United Kingdom in the hope that plants will prove easier and cheaper to use than current excavation and reburial techniques used for dealing with tainted soils. What's more, the nickel can be recovered by harvesting and burning the plants.

OLD PROBLEM, NEW COOKER

Fuelwood is an increasingly scarce commodity in Zimbabwe. To help the many households that use this energy source, the government has launched a programme to promote a cooker widely known as the "chingwa" (bread) which needs only a single log to prepare three meals, bake bread and heat water to bath the children. Women, who were at first reluctant to use the cookers, have been associated with the project. While they provide the raw materials for the cooker and its chimney (bricks and earth from ant-hills), the Energy Ministry provides the hot-plate, the grill and other accessories. All that has to be done is assemble and decorate the cooker.

© Béatrice Petit, Brussels

Isabelle Leymarie talks to

CHICO O'FARRILL,

one of the great figures of Latin Jazz

With his rich tonal range, "Chico" (Arturo) O'Farrill is the most famous composer-arranger of Cuban and Latin jazz. He began working with the leading Havana bands in the 1940s and later worked in New York with the Afro-Cubans ("The Afro-Cuban Suite", recorded with Charlie Parker, Flip Phillips and Buddy Rich), Dizzy Gillespie ("Manteca Suite"), Benny Goodman ("Undercurrent Blues"), Stan Kenton ("Cuban Episode"), Glenn Miller, Count Basie, Clark Terry, David Bowie and Gato Barbieri. He has also composed film music and classical works, including "Three Cuban Dances" and "Symphony No. 1".

He was born in Havana to a Cuban mother and an Irish father and spent a few years in an American military academy ("my father thought it would keep me out of trouble") where he played trumpet in the school band and took his first steps in jazz. Back in Cuba, he studied law for a year, but music won the day. In 1943 he joined Armando Romeu's Orquesta Bellamar and at the same time led an experimental band with a friend of his, guitarist Isidro Pérez.

In 1947 he moved to New York where he composed scores for a host of musicians, and in the early 1950s toured the United States with his own band. He then spent two years in Havana and went to Mexico in 1956 where he composed "Aztec Suite" and married the Mexican singer Guadalupe Valero. By 1965 he was back in New York.

Recently he formed a big band with which he has recorded *Pure Emotion*, one of his most accomplished records, and composed a piece for trumpeter Wynton Marsalis, which was premiered on 30 November 1995 at New York's Lincoln Center.

ISABELLE LEYMARIE
is a Franco-American musicologist.

■ How did you get started in music?

—Even when I was a child I was fascinated by Cuban rhythms, although mine wasn't a very musical family. At military school I fell in love with the recordings of Tommy Dorsey, Artie Shaw and Glenn Miller. But it was when I began to study Bunny Berigan's trumpet solos and transcribe arrangements that I found my real calling, writing music, not playing—because I had decided that I couldn't do both at the same time.

But back in Havana, I still played—with René Touzet, then with the Armando Romeu Jr. Bellamar band, the best Cuban jazz band at that time. We played the clubs until 1945, and I was lucky, thanks to the encouragement of more experienced musicians, to be able to do more and more composing. I also studied harmony and orchestration with Felix Guerrero.

■ Was a lot of jazz being played in Cuba at that time?

—Yes, probably because of the American tourists. Clubs would usually hire two bands, a big band with dancers, singers and comics that accompanied the revues, and a "b"-band that played Cuban music. The brass sections were smaller than in the United States, and bands used stock arrangements that they bought ready-made. The musicians' phrasing wasn't good. There wasn't much exchange with American jazzmen, and jazz records were scarce.

A few of us got together and formed a small band and gave free rein to experimentation. When bebop took off in the United States, I was immediately struck by Charlie Parker and Dizzy Gillespie. I spent hours studying their phrasing and trying to find harmonies on the piano. Cuban music seemed simplistic in comparison.

■ Were you able to turn your knowledge of bebop to good use in a big Cuban band?

—Yes. The Montmartre Club asked Isidro Pérez to form a band. We got together a fabulous big band, the Isidro Pérez Orchestra, with the best of Cuba's musicians. We did all our own arrangements just the way we wanted. But our modern ideas were often too much for the audience, who had a hard time dancing to the music. A year later, the Montmartre closed its doors, and I was out on the street.

So I made up my mind to try New York, where I carried on studying harmony with Bernard Wagenaar, Stephan Wolpe and Hal Overton. Then, after a hard spell financially, Benny Goodman took me on as an arranger.

■ Does Latin jazz call for any special know-how?

—You first have to know the jazz rhythms and Caribbean rhythms—a *guaguancó* is different from a *guajira* or a *bolero*—and avoid discordance. Cuban music tends to phrase farther behind the beat than jazz. But it's a question of ear and experience—and instinct, of course. I remember when we recorded the "Afro-Cuban Jazz Suite" with the Machito band in 1948, the producer, Norman Granz, hired the trumpeter, Harry Edison. But Edison was an honest guy and realized in rehearsals that he wasn't used to that kind of phrasing. He decided to bow out, so Granz called Charlie Parker, who, extraordinary musician that he was, got the idea right away.

■ What do you think of Latin jazz today?

—There's a lot of new talent. When I made *Pure Emotion*, my son Arturo Jr., who is a pianist, recruited the musicians. They were all incredibly talented! The media encourage cultural mixing and the spread of Latin-American rhythms, but I'm not expert enough to get involved with kinds of music I don't know. My roots are still in Cuban music. There, and in jazz, I know what sounds good.

■ You hadn't made a record for years. Why did you make *Pure Emotion*?

—I've spent a lot of time writing music for the market, which gives me a decent living, but a producer talked me into making this record. *Pure Emotion*, the title piece, is a slow ballad that's got hardly anything Latin in it. *Variations on a Well-known Theme* is based on the theme of *Cucaracha* and has a very advanced arrangement with complex harmonies and a number of transformations. I wrote it in Mexico in 1965 and I've played it in Los Angeles and elsewhere. I put *Get me to the Church on Time*—a Broadway standard—to a mambo beat. There's a lot of variety on the record.

■ Has Latin jazz got a future?

—Yes. It's music that's constantly regenerated by new input. If Latin jazz died out, it would mean that American jazz was also dying, and the Western world would be in trouble! ■

children and violence on the screen

by Nils Gunnar Nilsson

A growing number of countries are concerned about violence on the screen—on television or in computer games—and a number of meetings have been held on the subject in different parts of the world. In March 1995 a world summit on children and television was held in Melbourne (Australia), and an international conference in Lund (Sweden) in September was totally devoted to violence on the screen and the rights of the child.

At Melbourne more than 500 producers, researchers, media executives and other experts took part in a number of panels. A proposal by Anna Home, Head of BBC Television Children's Programmes, for a "children's television charter" led to a wide-ranging debate. The proposal suggested certain minimum requirements such as balanced programming, broadcasting in regular slots when children are able to watch, a wide diversity of content, and sufficient funds.

After heated discussion, the charter was revised into a new seven-point version which is now considered official. The first point stresses that children have the right to high-quality programmes which are specifically made for them and "which do not exploit them". This is a reference to the fact that children have become a steadily growing consumer group in the expanding world of children's television. This was highlighted by Ellen Wartella, professor of communication at the University of Texas, who pointed out that we have learned that children are a "special" audience, with "special psychological needs and social interests, requiring us to tailor media production to them". There has been "a virtual explosion of research studies on children's reactions to television," she added, "and we know how to make programmes that both entertain and educate children."

Professor Wartella went on to discuss an alarming phenomenon, "the increasing commercialization of children's lives." "The past twenty-five years have seen media industries move their target downwards," she noted, "first to pre-adolescents, then to children in primary school and younger, and the vehicles for this have been television and videos. Today young children all over the world, even pre-schoolers, are increasingly the target of commercial messages. Young children's culture is a culture dominated by television and toys." With the rise of privatized commercial television all over the world, thanks to satellite and cable, a "remarkably commercialized media culture for children" is being created, at a time when public broadcasting is under attack and declining.

At the Lund conference, more than 140 delegates from twenty-five countries took part in or listened to the five panel discussions, ranging from "reports from the research front line" to artistic depictions of violence "From Shakespeare to Stephen King". In one session representatives from the media were confronted with defenders of children's rights; another session focused on the Convention and its implementation, and the final panel asked the question: Where do we go from here?

One panelist, ambassador Thomas Hammarberg (co-chairman of the United Nations Commission which is monitoring the implementation of the Convention), argued strongly for a joint UNESCO-UNICEF commission which would organize a clearing house where research and other information could be col-

NILS GUNNAR NILSSON,
a Swedish publishing and media specialist, is a member of UNESCO's Executive Board.

Drawing by Terry Sirrell.

lected and distributed, and possibly publish an annual blacklist of the names of the media companies with the worst record of violence on the screen. The Swedish Minister of Culture, Ms Margot Wallström, who chaired the summing up panel, supported the idea of a clearing-house and was willing to give financial support at the outset.

UNESCO will be publishing a full report of the Lund Conference later this spring. The ideas that were put forward there are also reflected in the conclusions of an international survey, *Violence in Broadcasting Worldwide*, prepared for UNESCO by the Broadcasting Standards Council in Britain, which will also be published in the near future.

It was clearly stated in Lund that the answer to the problem of growing violence on the screen is not censorship. This conclusion is repeated in UNESCO's recent far-reaching *World Report on Culture and Development*. Freedom of expression is a fundamental freedom. The best way to cope with excesses in violence, and even pornography is to use the power of the consumer. In a free market economy, where most media are commercially based, the viewer-consumer actually has the last word, at least theoretically. You can push the button and say "no thank you. We don't buy products which are advertised in too violent a media environment". If there's anything big companies are scared of, it's a bad image.

Ultimately, it's a matter of consciousness raising. Twenty or thirty years ago, most people did not know the word "ecology". Today it's on everybody's lips. Jo Groebel, professor of mass communication at the University of Utrecht (Netherlands), and a world authority on research into violence in the media, has made the following comparison. "In the 1960s and 1970s we thought we had got rid of toxic substances when we dumped them out of sight in rivers and oceans. Later on, we learned the hard way that poisonous waste does not disappear; it reappears just where we never expected it."

Perhaps the time has come to start thinking in terms of "media ecology". ■

The divorce between science and 'culture'

by Bertrand Russell

There was a time when scientists looked askance at attempts to make their work widely intelligible. But, in the world of the present day, such an attitude is no longer possible. The discoveries of modern science have put into the hands of governments unprecedented powers both for good and for evil. Unless the statesmen who wield these powers have at least an elementary understanding of their nature, it is scarcely likely that they will use them wisely. And, in democratic countries, it is not only statesmen, but the general public, to whom some degree of scientific understanding is necessary.

To insure wide diffusion of such understanding is by no means easy. Those who can act effectively as liaison officers between technical scientists and the public perform a work which is necessary, not only for human welfare, but even for bare survival of the human race. I think that a great deal more ought to be done in this direction in the education of those who do not intend to become scientific specialists. The Kalinga Prize is doing a great public service in encouraging those who attempt this difficult task.

In my own country, and to a lesser degree in other countries of the West, "culture" is viewed mainly, by an unfortunate impoverishment of the Renaissance tradition, as something concerned primarily with literature, history and art. A man is not considered uneducated if he knows nothing of the contributions of Galileo, Descartes and their successors. I am convinced that all higher education should involve a course in the history of science from the seventeenth century to the present day and a survey of modern scientific knowledge in so far as this can be conveyed without technicalities. While such knowledge remains confined to specialists, it is scarcely possible nowadays for nations to conduct their affairs with wisdom.

There are two very different ways of estimating any human achievement: you may estimate it by what you consider its intrinsic excellence; or you may estimate it by its causal efficiency in transforming human life and human institutions. I am not suggesting that one of these ways of estimating is preferable to the other. I am only concerned to point out that they give very different scales of importance. If Homer and Aeschylus had not existed, if Dante and Shakespeare had not written a line, if Bach and Beethoven had been silent, the daily life of most people in the present day would have been much what it is. But if Pythagoras and Galileo and James Watt had not existed, the daily life, not only of Western Europeans and Americans but of Indian, Russian and Chinese peasants, would be profoundly different from what it is. And these profound changes are still only beginning. They must affect the future even more than they have already affected the present.

At present, scientific technique advances like an army of tanks that have lost their drivers, blindly, ruthlessly, without goal or purpose. This is largely because the men who are concerned with human values and with making life worthy to be lived, are still living in imagination in the old pre-industrial world, the world that has been made familiar and comfortable by the literature of Greece and the pre-industrial achievements of the poets and artists and composers whose work we rightly admire.

The separation of science from "culture" is a modern phenomenon. Plato and Aristotle had a profound respect for what was known of science in their day. The Renaissance was as much concerned with the revival of science as with art and literature. Leonardo da Vinci devoted more of his energies to science than to painting. The Renaissance artists developed the geometrical theory of perspective. Throughout the eighteenth century a very great deal was done to diffuse understanding of the work of Newton and his contemporaries. But, from the early nineteenth century onwards, scientific concepts and scientific methods became increasingly abstruse and the attempt to make them generally intelligible came more and more to be regarded as hopeless. The modern theory and practice of nuclear physicists has made evident with dramatic suddenness that complete ignorance of the world of science is no longer compatible with survival. ■

The above is the text of an address delivered by Bertand Russell, on receiving the Kalinga Prize for the Popularization of Science, at UNESCO Headquarters on 28 January 1958.

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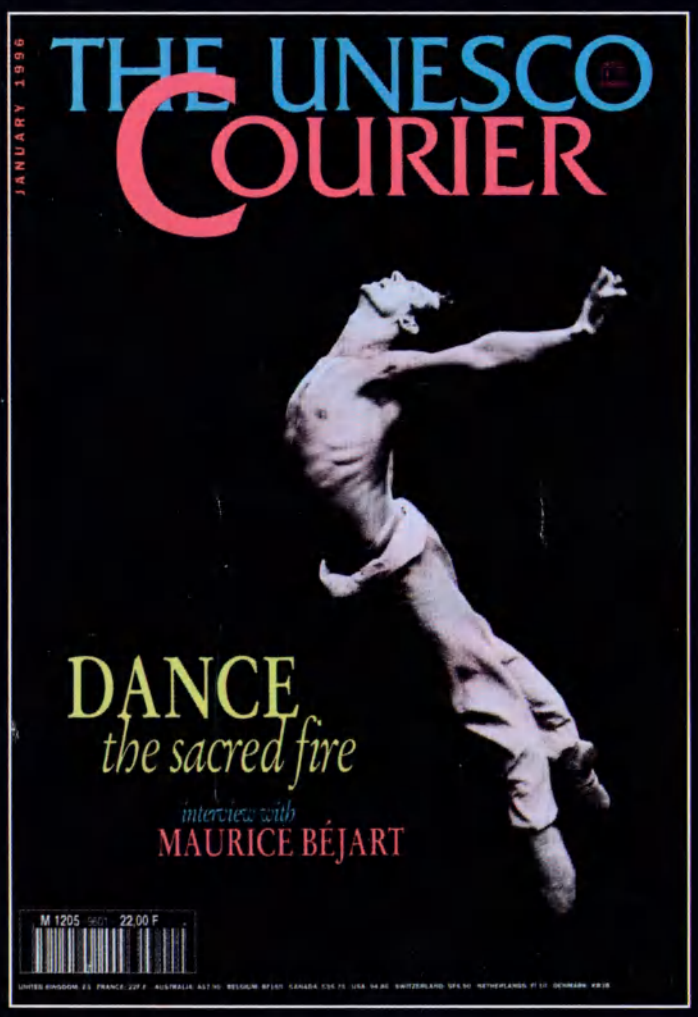

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